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DARWIN AS A TRAVELLER

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THE SUBJECT OF DARWIN as a traveller can only refer to the celebrated Voyage of the *Beagle*, since to all intents apart from this he never travelled at all. For example, in all his life he only once set foot on the continent of Europe, when as a youth he went as far as Paris with some cousins. The story of the *Beagle* has been often told, but the emphasis has usually been on the scientific developments to which it led. Here the proportions will be different, for the journey itself will be the central interest, and I shall describe some of the tours he made by sea and by land, in plains and on mountains, with hardly a reference to their scientific results.

In compiling my account of the voyage, I have drawn largely on the volumes about it written by Captain Fitzroy. As to the 'Naturalist's voyage' itself I have used Lady Barlow's book on it which was published in 1933. This was compiled from the actual diaries of the voyage, whereas in the original edition, published by Darwin in 1839, there were supplements drawing scientific conclusions which were made later after he had got home and could examine the collections he had sent back. In 1945 she published the actual notebooks which he had compiled day by day, and these have also been useful. My main sources have therefore been Fitzroy's volumes and Lady Barlow's two books.

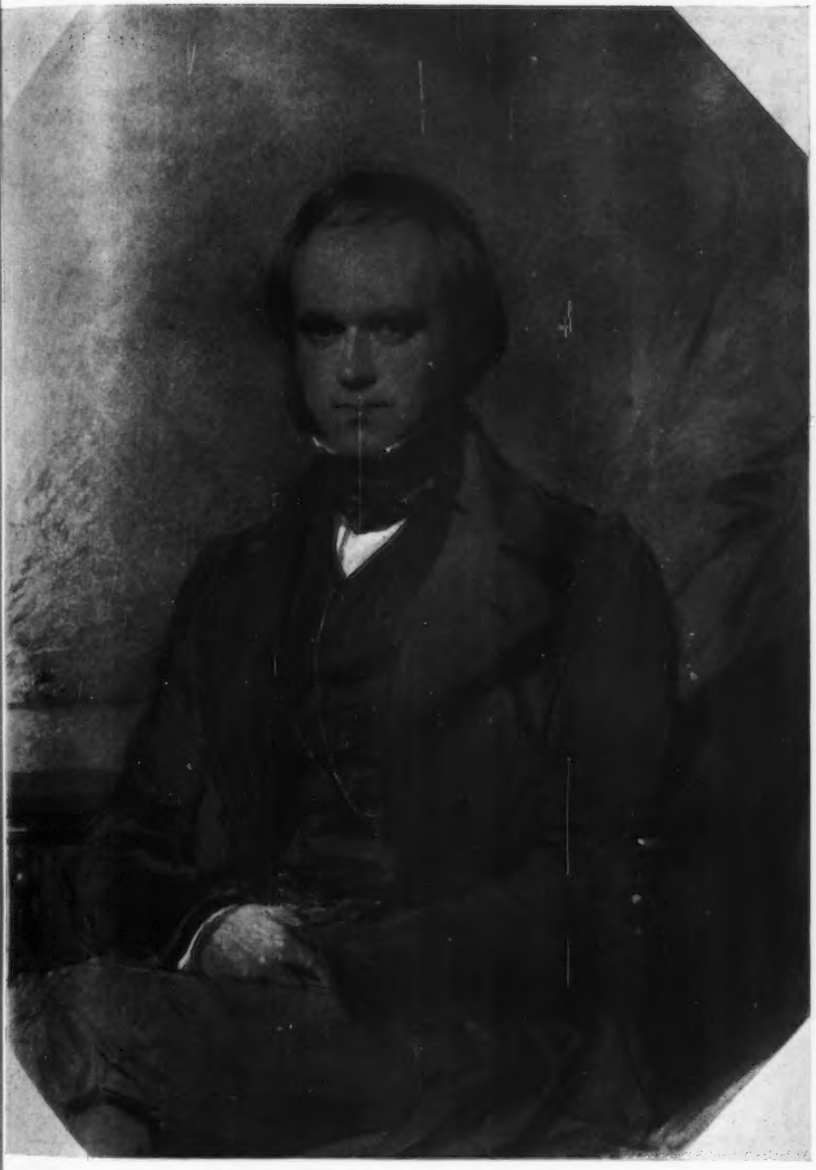
The famous voyage was not in fact the first tour of duty of the *Beagle* in South America. In 1826 the ships *Adventure* and *Beagle* had made a general survey of the coasts of the southern parts of the continent. The commander of the *Beagle* died in 1828 and he was succeeded by Robert Fitzroy who was later to be in command also during the second voyage. Later again it was he who wrote two of the volumes recounting both these voyages. One only has to read the Journal to realize that Fitzroy was a most remarkable man. He was the grandson of the third Duke of Grafton and on his mother's side he was a nephew of the great Lord Castlereagh. He was obviously highly expert as a navigator as well as a good commander and a very good seaman. But he added to all these essential qualities a further one, in that he was a good writer, so that his descriptions at once come alive to the reader in a way that the previous accounts had not.

A few events of the first voyage had their effects on the second. One was the discovery in Tierra del Fuego, not far north of Cape Horn, of a channel running nearly straight east and west for a hundred miles. It had been quite unknown, and they had not the time to explore it properly, and the Beagle Channel obviously called for further survey. For much of the way this channel is in fact now the frontier between Chile and Argentina. During their time in Tierra del Fuego there had been much difficulty because the crew could not understand the natives' language. To remedy this Fitzroy persuaded three Fuegians to come on board to

serve as interpreters, and with their full goodwill he brought them back to England so as to educate them, with a view to the later foundation of a mission station out there. One was a man whom they called York Minster, naming him after a mountain near which he had joined them, the second was a girl whom they called Fuegia Basket, and the third a boy they called Jemmy Button. The re-establishment of the three in Tierra del Fuego was one of the important tasks for the second journey. Furthermore, Fitzroy was much impressed by the opportunities which were being neglected because the naval surveyors were quite ignorant of geology, and he resolved that in any second voyage he would try to remedy this by inviting a naturalist to join the ship. It was this post that was taken by Darwin, who when the two men first met was only twenty-two years old, while Fitzroy himself was only twenty-six.

The *Beagle* returned to England in 1830, and in the summer of 1831 she was recommissioned to complete her survey, again under the command of Fitzroy. Her burden was only 240 tons, and the crowding was quite formidable, since there were 76 people on board. In addition to the ordinary crew and the marines, there were the specialist surveyors. Then there was Darwin, and also an artist, Earle, engaged for the voyage, though he was later replaced by another and in fact a rather better artist called Martens. Finally there were the three Fuegians, and a missionary Richard Matthews who had volunteered to go and start the station in Tierra del Fuego. Darwin messed with Fitzroy, but he slept in a cabin with two junior officers, Stokes and King, and the space was so cramped that a drawer had to be removed from a cupboard in order to sling his hammock. For the purposes of geology he took a hand lens, microscope, blow-pipe equipment, goniometer and a magnet. He had pistols, and guns for shooting game, and a small, carefully selected library of books, which included Humboldt's travels, the first volume of Lyell's 'Geology,' which had only just been published, and Milton's poems.

The *Beagle* was charged with the duties of completing the survey of the southern part of South America on both east and west sides, and she was also to do a circumnavigation for the determination of longitudes. There was also the obligation of taking the Fuegians home and setting up the mission station. For the longitudes the *Beagle* carried among other equipment a set of twenty-six chronometers, lettered A to Z, and though of course some of these failed in the course of time, there remained about a dozen still in working order at the end of the five years' voyage. It is interesting to note that at the end of this very long period the closing error for circumnavigation was only 32 seconds of time. The survey ships of those days had acquired a bad reputation in naval circles for the health of their crews, but this reputation was not borne out during the second voyage. Allowing for the fact that much of the time was spent in the tropics, their health was excellent. It would seem also to have been a happy ship. Darwin must have proved himself a good messmate, for he maintained touch with several of the officers for years afterwards, as he also did with Covington, the man who acted as his servant for much of the voyage. The relations of anyone on board a ship with the Captain are likely to be rather more difficult on account of his autocratic position. Aside from this, to share all meals with anyone continuously for five years would be trying, and with a man of Fitzroy's strong character there might be grave danger of a complete breakdown. They did have two or three quarrels, but they were soon reconciled again each time. However, Fitzroy's narrow fundamentalist religious views were not to be reconciled with the Evolutionary Theory, and I believe that though in later years they occasionally met, it was judged too dangerous ever to continue the intimate acquaintance.



Charles Darwin as a young man, 1840

70°
60°
Miles
100 0 100 200 300 400
30°
Coquimbo
Cordoba
Santa Fé
R. Parana
R. Uruguay
Aconcagua
Uspallata Pass
Portillo Pass
Valparaiso
Mendoza
Santiago
Rosario
URUGUAY
Buenos Aires
Rio de la Plata
Maldonado
Montevideo
ANDES
ARGENTINA
Concepción
Sierra de la Ventana
Bahia Blanca
R. Colorado
Valdivia
R. Negro
40°
Carmen de Patagones
Chiloe I.
SOUTH
R. Chubut
ATLANTIC
R. Chico
Chonos Archipelago
OCEAN
R. Deseado
Puerto Deseado
Puerto San Julian
L. Viedma
R. Santa Cruz
Santa Cruz
L. Argentino
50°
Falkland Islands
Strait of Magellan
Str. of Magellan
TIERRA DEL FUEGO
C. San Diego
Staten I.
Cape Horn
DRAKE STRAIT
TIERRA DEL FUEGO
Sarmiento
Darwin
Beagle Channel
Wooly
Darwin Sd.
100 miles
Cape Horn
80°
70°
60°
50°

Figure 1

The *Beagle* was ready to start from Plymouth in November 1831, but contrary winds drove her back several times, and she only finally left these shores on December 27. In crossing the Bay of Biscay Darwin had his first experiences of seasickness, from which he suffered acutely during the whole voyage whenever the weather became at all stormy. After calling at the Cape Verde Islands and St. Paul's Rocks on the equator in mid-Atlantic, the *Beagle* arrived in Brazil, and stayed some time at Bahia. Here for the first time Darwin saw the wonders of a tropical forest, and I think for the rest of his life he perhaps counted this as the most outstanding experience he ever had. "The delight one experiences in such times bewilders the mind; if the eye attempts to follow the flight of a gaudy butterfly, it is arrested by some strange tree or fruit; if watching an insect, one forgets it in the stranger flower it is crawling over; if turning to admire the splendour of the scenery, the individual character of the foreground fixes the attention. The mind is a chaos of delight out of which a world of future and more quiet pleasure will arise." In the whole course of the voyage there are only two other things that made such a tremendous impression. One was the first sight of a primitive Fuegian savage, and the other was a view from a pass over the Cordillera near Santiago de Chile.

From Bahia they moved on to Rio, and there Darwin and some of the crew spent a couple of months, because the *Beagle* had to return to Bahia to clear up a question of the longitudes. After that they moved to Montevideo which was to be their base for the next two years for the survey work on the east coast. It would be out of place to describe the complete itineraries of the voyage. The ship was much of the time engaged in detailed surveys of rather uninteresting coasts, and during these times Darwin was free to make tours inland. He made a number of journeys, some of them quite dangerous and certainly adventurous, but I can only give an account of a few of the more salient events in this period.

Their first tour was by ship to Bahia Blanca, which is now a large town with great factories and docks for the export of grain, but then it was a difficult port to enter on account of the sandbanks. Their reception was embarrassing, because the *Beagle* was the first warship ever to enter there, and the governor suspected they were going to annex the country. His suspicions were much increased when he was told that Mr. Darwin was "un naturalista", and when it was explained that this meant "a man that knows everything", his anxiety was increased further. However, later on papers came from Buenos Aires verifying their harmless character, and they were accepted and well treated. Darwin discovered some very interesting fossil beds containing bones of the great megatherium. In November they returned north to the River Plate, and this time they visited Buenos Aires, which was a much larger and more prosperous city than Montevideo, even though it was suffering periodically from revolutions. He records that there were many English shops there where one could buy useful things. In his notebook there are lists of things to be bought, which include "Bramah pens, notebooks, watch mended, great teeth" (I do not know what the last means—perhaps fossils). There is also a note of the beauty of the Spanish ladies there, whose appearance, as he tells his sisters in a letter, much outshone the English ladies' at home.

The next voyage was to Tierra del Fuego, for the survey of the Beagle Channel, and also in order to set up the mission. This was in high summer, February 1833, but they encountered bad storms. In the end they set up the mission at a place called Woolya, near the Channel and in Jemmy Button's country. York and Fuegia were now married, and they agreed to settle there too though it was not their own country. They were soon joined by Jemmy's family, but also unfortunately by many other natives. These stole everything they could of the equipment, and

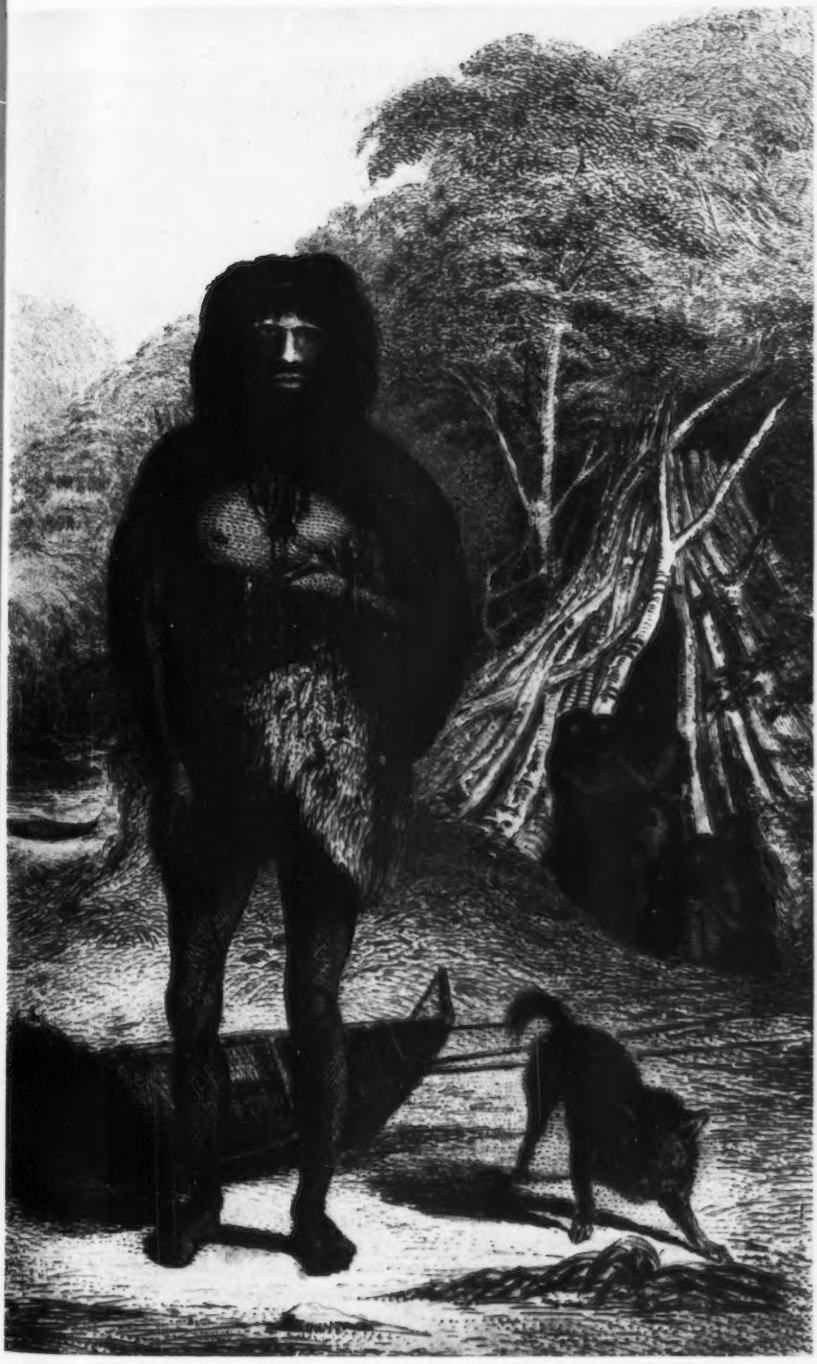
constantly trampled on the gardens that had been planted with peas and potatoes. It was very doubtful if it would be safe to leave Matthews alone with the savages, and it was decided to give the matter a short trial.

This trial was possible because one of the objects of the cruise was the survey of the Beagle Channel and beyond, and this was to be done in two boats. Including Darwin they set off westwards from Woolya, through the various sounds right beyond the end of the Beagle Channel. One of these was named Darwin Sound by Fitzroy, who also gave his name to Mount Darwin, a mountain slightly northwards, thought to be only very little lower than the great Mount Sarmiento. It was a very rough life—most of the time they were wet through—camping in small tents anywhere they could find a secure place for the boats, and which was not, as many of such places were, a swamp. Also they had to be well away from the thieving natives.

They had one near disaster. The boats were safely up on the beach at a little distance from the encampment, in a bay near a place where glaciers from Mount Darwin came right down to sea level. Suddenly they heard a mighty crash, and a whole wall of ice fell off into the water. There were continual echoes from all the mountains round, but to their horror they saw a great rolling wave advancing towards them which would have destroyed the two boats. The most active members of the party dashed off to secure the boats, and they were successfully hauled up out of reach of the second and third rollers without damage. As Fitzroy writes, "Had not Mr. Darwin, and two or three of the men, run to them instantly they would have been swept away irrecoverably." If this had happened, the boats would either have been stove in on the rocks or, if they escaped that, they would have been stolen and broken up by the Fuegians. It would have been quite a chance whether a canoe could have been constructed to get to the *Beagle* and bring a rescue party.

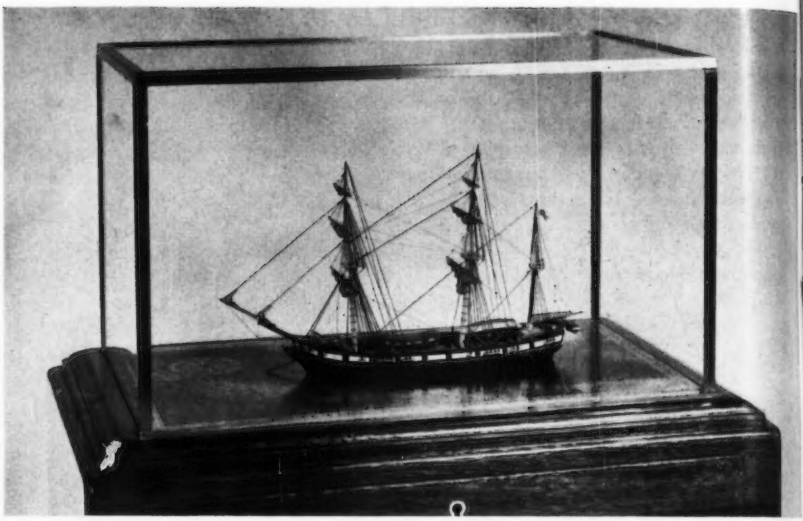
They were away on this trip for nine days, going about 300 miles in all, and when they approached Woolya again their anxiety to see Matthews's fate may be imagined. He was safe, but had had a trying time, hardly able to sleep because any relaxation meant that his things were snatched or stolen. He was also maltreated to some extent, and threatened when he refused to give things away. York and Fuegia had fared better, but Button was plundered a great deal, even by his own family. Indeed when any of the natives were seen near by, they were usually found to have some form of loot, either clothes or tools. The gardens that had been so carefully planted had been entirely trampled over. It was evident that Matthews could not stay there, so he was taken off back to the ship, and gave up the mission. In fact he had a brother as a missionary in New Zealand at the time, whom he expressed the wish to join, and this he did. The three Fuegians all decided to stay at Woolya.

Immediately after this the *Beagle* left for the Falkland Islands, but about a year later she was back in Tierra del Fuego on her way through to the west coast, and they revisited Woolya. It will be best to finish off the story of the Fuegians here, rather than in chronological order. When they got to Woolya they found the place deserted though the huts were still standing. However, not long afterwards three canoes were observed to be approaching, and it proved to be Jemmy Button and his brother Tommy, and among others a wife Jemmy had acquired. Jemmy was naked except for a bit of skin round his loins; his hair was long and matted and he was very thin. He declared he was entirely happy. He spoke as much English as ever, and he had converted all the family to the use of many English words. Fitzroy brought him on board, gave him some clothes to wear and they sat down to a meal together, which he ate in quite a civilized manner with knife and fork. In exchange



A Fuegian

From 'Voyages of H.M.S. Adventure *and* Beagle'



Model of H.M.S. Beagle *made by A. G. Law of New Jersey with the help of the Admiralty and of the National Maritime Museum, Greenwich*

Button Island, near Woolya, Beagle Channel

From 'Voyages of H.M.S. Adventure *and* Beagle'

for the presents he received, he gave Fitzroy a very fine otter skin, and other presents to his favourites among the crew.

His story was this. For some time York and Fuegia his wife seemed quite settled, though there was a suspicion because York was spending much of his time in building an exceptionally large canoe. At one time they had been set upon by a tribe of enemies, but escaped to some island and took no harm, nor were their wigwams damaged. Then later York persuaded Jemmy to go off with them, as he said, "to look at his land." They all went amicably as far as Devil's Island where the Beagle Channel forks into two branches, and there after meeting some of York's family, while Jemmy was asleep one night they robbed him of all his clothes and property and made off. I believe later on that when a mission was really established in Tierra del Fuego, Jemmy had a good deal to do with it, so that it may be felt that Fitzroy's missionary efforts were not entirely wasted.

After a short visit to the Falkland Islands the *Beagle* returned to the River Plate, and Darwin went ashore at the small town Maldonado in what is now Uruguay. Here he gave up some time to lessons in Spanish. In his later life he was almost famous for being bad at foreign languages, but I think there can be little doubt that at this time he became competent at Spanish, since for many of his journeys he was living exclusively among gauchos and seems to have had no difficulty. From Maldonado he went a short tour in the surrounding country, but the only interesting thing to note about it is that the people were much excited by two of his possessions, one a magnetic compass, and the other what were then called prometheans, the earliest form of matches.

In the early spring of 1833, that is in August, Darwin went on the longest and I think the most dangerous of his land tours. The *Beagle* was engaged in surveying the coast of southern Argentina, and carried him down to the Rio Negro. From there he was to go north—of course all done on horseback, with several horses to each man—across the Rio Colorado to Bahia Blanca. This would be nearly 200 miles. There he would meet the ship again and then move on 400 miles to Buenos Aires. The whole country was engaged in warfare between the gauchos and the Indians. It is hardly an exaggeration to say it was a war of extermination, though quite a number of Indians were supporting the Spaniards. He was naturally shocked by the inhumanity of it, but there does come out the impression that the country would never be properly settled until the Indians found they could not make continual raids from the Cordillera. The country from Carmen de Patagones to the Colorado is semi-desert, with a good many salt-pans and very little water anywhere. Its only inhabitants were scattered bands of guanacos, that is to say wild llamas, and ostriches, with their attendant beasts of prey, and armadillos and the usual small rodents. At the Rio Colorado they met the army that was fighting the Indians. It was under the command of General Rosas, who by all accounts was a good and popular commander though very despotic. They had to get passports from him so as to go on. The General expressed interest in Darwin's plans, and granted him an interview, which passed off "with great and unsmiling dignity." He was made free to continue his journey the whole way to Buenos Aires, being granted the use of the various military posts planted along the route.

When they arrived at Bahia Blanca the *Beagle* had not yet arrived, and a tedious week was passed, though enlivened by minor excursions, in particular to the fossil beds where he had previously discovered the bones of a megatherium. After a few days to re-equip himself in the ship, he set off on the 400-mile journey to Buenos Aires. For part of this it was arranged by General Rosas that they should be accompanied by a troop of five soldiers. They in fact had no trouble on this journey,

though at one of the posts a man had been killed by the Indians only a day before, and another post had been entirely massacred only a month or so before, so that life was not exactly safe.

As the traveller goes north the country gradually gets less arid, and it ends in the comparatively fertile and populated country near the capital. For most of the way it is perfectly flat pampas, but there is one mountain standing up out of the plain, the Sierra de la Ventana, a landmark for a hundred miles round. Darwin took a day off by himself to climb this, with various excitements, such as when he saw two horses half way up, and lay for some time waiting to see if there were Indians about. However, there was nobody, so he went on, but he then discovered that the mountain-climbing muscles are very different from the horse-riding ones, so that he got too cramped and exhausted to reach the very highest of the mountain's four main peaks. They took a fortnight to reach Buenos Aires, and there Darwin enjoyed the hospitality of an English merchant's comfortable house.

After a few days' rest he set off up the Parana to Santa Fé some 200 miles northwest. This was on horseback, but at Santa Fé he was taken ill and had to return down the river by boat. He next did a tour from Montevideo round the basin of the River Uruguay. The only notable thing about this tour was that at one place the inn-keeper asked his guide if Darwin was a Gallego, which signified whether he would be worth murdering!

The *Beagle's* period on the east coast was now nearing its end. Apart from the second visit to Tierra del Fuego, which I have already described, there are two further incidents worth recounting. The *Beagle* was surveying the remoter southern shores of the deserts of Patagonia. They called in at Port San Julian. The river here was quite insignificant and a party set off to walk over the desert country westwards. They were loaded with arms and the survey instruments, but they did not bring enough water and suffered terribly from thirst. Finally Fitzroy and several of the men became absolutely exhausted, but, seeing what looked to be a lake further on, Darwin and one of the men walked on a couple of miles to it only to find that the lake was pure dry salt. Seeing another lake beyond, they went on a further 2 miles, only to be again disappointed. In the end Fitzroy and some of the men were left behind with the arms and the rest got back to the ship, and sent out a rescue party with the much needed water-bottles. They had been without water for seventeen hours. Darwin seems to have stood up to the ordeal better than any of them, though he paid for it by spending the next two days in his hammock with a high fever. An interesting point about this incident is that in later life Darwin became almost famous for his ill health, yet during the voyage he was distinguished for his strength and vigour. On at least two occasions—this one and the one I have cited already about saving the boats in the Beagle Channel—Fitzroy distinguished him for these qualities among the whole crew. It is true that he had various sicknesses during the five years of the voyage, including a serious one later at Valparaiso, but there is little evidence that his ill-health in later life was due to the stresses of the voyage.

After this expedition there was a second visit to the Falklands, and the second visit to see Jemmy Button, that has already been told. However, in the course of her work the *Beagle* had gone aground somewhere, and slightly damaged her hull, and before going to tropical waters, infested by shipworms, Fitzroy decided to lay her up and restore the coppering of the hull. This was done at the mouth of the Rio Santa Cruz, still further south in Patagonia, because there was a big tide there which made it possible to beach her. The stay here was used by Fitzroy to explore the upper reaches of this practically unknown river. It flows from the

Cordillera in a deep valley cut in the usual Patagonian flat plain about 400 feet above it, which is nearly a complete desert. Three whale-boats were fitted out, but the current was so strong that they had to be towed the whole way, the twenty or so members of the party all taking turns at the towing while there were one or two scouts out on the hills above to give warning of possible attacks. There were traces of Indians in various places, but in fact they saw none. They did see quite a number of guanacos and a few ostriches, and also condors, but there was no other life there. After fourteen days of this back-breaking work, they reckoned they were 140 miles in the direct line from the mouth of the river, and about 245 by the river's winding course. From the side hills the Andes could be seen stretching across the whole western horizon, and they reckoned they were ultimately only 60 miles from the Pacific. Their provisions were by then nearly exhausted and everyone was foot-sore and weary, so that Fitzroy decided they should spend one day, leaving the boats and going on as far west as they could walk. Above the actual river valley it was the same flat desert as ever. The next day they got into the boats, and returned to the river's mouth. They did 85 miles the first day, which in going up had cost them six days, and arrived back at the *Beagle* in three and a half days in all.

This ended the *Beagle's* stay on the east coast, and she moved over to Chile to complete the survey of the west. This part of the voyage is somehow less exciting than that in Argentina, and it can be told more quickly. The west side of Spanish South America was in fact settled long before the east, so that it gives the impression of having been a good deal more highly developed, and the various tours that Darwin undertook are therefore less exciting. There was one round the island of Chiloe, and then one round the neighbourhood of Valparaiso, including Santiago. At the end of this he was taken very seriously ill with some sickness that has never been diagnosed, and he had to spend a month in bed in the house of an English merchant in Valparaiso. However, he seems to have recovered completely and later he did another tour among the great mountains, over the Portillo Pass to Mendoza on the east side, and back over the Uspallata Pass to Valparaiso. Later again he took two months on a journey of 400 miles northwards along the Chilean coastal plains, visiting mountains and mines on the way, and he rejoined the *Beagle* at Copiapo in the desert regions of northern Chile. The outstanding event of this period was a great earthquake which destroyed the city of Concepcion. The *Beagle* went there to help in the relief work, and Darwin was much interested by the changes of sea level caused by the earthquake. In the course of his journeys he had frequently come across beds of marine shells at great altitudes, and it was these observations that suggested to him his theory of coral reefs, in fact before he had ever seen a coral island. It was the publication of this theory, when he had fully confirmed it by observation and study, that first brought his name into the hierarchy of leading zoologists.

From Copiapo the *Beagle* went on to Lima, where Darwin did a short tour up the mountains, and then the ship proceeded to the Galapagos Islands, which was the last part of the voyage in which she was to do detailed charting. It was here that Darwin became convinced of the principle of evolution, that species were not immutably fixed, which had been the accepted doctrine hitherto. It was observation of the peculiar species, often different from one another in adjacent islands, that convinced him of this principle.

After the Galapagos the character of the voyage changed, because its concern was no longer with the making of charts, but only with the determination of longitudes. This meant that only comparatively short stays were required at each station during the circumnavigation. They called at Tahiti, then at the Bay of

Islands in New Zealand, and then at Sydney, where Darwin did a hundred-mile tour to the Blue Mountains. Next came Hobart Town in Tasmania, and then King George's Sound in south-western Australia. From there they went to Keeling Island, then across the Indian Ocean to Mauritius, and so to the Cape of Good Hope, where again Darwin did a hundred-mile tour. The *Beagle* then called at St. Helena and Ascension Island on her way to Bahia where the circle of the Earth would be completed. From there she called at Pernambuco, the Cape Verde Islands and the Azores, before finally reaching Falmouth on 2 October 1836.

In Darwin's diary, at its end, there are a few pages given to reflections on the advantages and disadvantages of foreign travel. It is well worth reading, but I am not going to describe it. However, I found one interesting point in it that I had hardly expected. As I have already mentioned, the three things that most impressed him in the whole voyage were the tropical forest, the Fuegian savage, and the Cordillera mountains. But here he notes the fact that when he recalls the memories of those five years, he finds that it is none of these that first arises in his mind. It is the plains of Patagonia, without habitations, water, trees or mountains and only a few dwarf plants. I think that in reading the diary one does form the impression that it was the later period spent on the east side of South America that was the central feature of the whole of this great voyage.

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DISCUSSION

Evening Meeting, 18 October 1959

The PRESIDENT (The Rt. Hon. LORD NATHAN) introduced the speaker, and after Sir Charles Darwin had read his paper, Lord Nathan invited Sir Gavin de Beer, Director of the British Museum (Natural History), to speak.

Sir GAVIN DE BEER: The great Society which you adorn as President has performed an act of piety this evening in paying tribute to Darwin as a great traveller in a country in which it was a rare adventure to travel a hundred and thirty years ago. I am quite certain that the reason for that is the dazzling light with which, I won't say he blinded, but he prevented his hearers from associating himself with anything but natural science, and particularly geology in the first place and natural history in the other. Otherwise, my Lord President, I have no doubt that your predecessors would have awarded the Gold Medal to Charles Darwin except for one thing, and that is, that these illustrious predecessors all stood very well in the eyes of Queen Victoria, and I doubt whether that gracious and great Majesty would have approved. Now, far be it from me to add anything to what Sir Charles Darwin has said about the Voyage of the *Beagle*, which I insist is the finest book of travel ever written. I defy anybody to read it from cover to cover—any more than the 'Origin of Species,' there is too much

in it—but wherever you pick it up, you will find interest, and also original observations which had never been made before.

This is not the only Society which ought to pay tribute to Darwin. It has occurred to me over the last few days to consider those instances in the Diary and the Journal where Darwin shows the spirit of the founders of the Alpine Club. I am afraid we have not the pleasure of the presence of Sir Edmund Hillary who honoured us at the Dinner because he has to fly back to New Zealand in a few minutes, and I do not know whether any other members of the Alpine Club are present, but if there are I hope they will forgive me if I just point out a few of the remarkable instances in which Darwin showed the spirit which laid the foundations of that Club in 1857. For example, on 20 December 1832, Tierra del Fuego: "I was anxious to reach the summit of this mountain,"—the first thing he did as soon as he got ashore; and then in September 1833 on the Sierra de la Ventana he had great difficulty in getting up that mountain. In the first place, when he climbed what he thought was the peak he found it wasn't and he had to go all the way down again and go up to another peak; and, in between, in a valley, he saw two horses, and that was extremely suspicious because if there were two horses, there ought to be two riders, and if there were riders they were probably Indians. He describes in his inimitable, very dramatic style how, having got down from the first peak, he hid in the grass to reconnoitre to see whether the horses had riders, and if there were any whether they were Indians, and he decided they were not and he went up to the second peak.

Sir CHARLES DARWIN: The story is that he never got up the second peak because he found that the muscles with which you ride horses are quite different from the muscles with which you climb mountains.

Sir GAVIN DE BEER: An observation of a physiological nature which is only too true, Sir. Mount Tarn in the Straits of Magellan: "reached the bare ridge which conducted us to the summit. . . . Our descent was not quite so laborious as our ascent; for the weight of the body forced a passage, and all the slips and falls were in the right direction." And then, 1834, Bell Mountain in Chile: "We climbed up the rough mass of greenstone which crowns the summit. This rock, as frequently happens, was much shattered and broken into huge angular fragments. I observed, however" (you see what it is to be a geologist) "one remarkable circumstance, namely, that many of the surfaces presented every degree of freshness—some appearing as if broken the day before, whilst on others lichens had either just become, or had long grown, attached. I so fully believed that this was owing to the frequent earthquakes, that I felt inclined to hurry from below each loose pile." It would be a new experience for ski-runners and mountaineers to hurry past dangerous slopes not because of fear of avalanches but for fear of earthquakes.

And so it goes on in Chile, where he scrambled up a peak near Cape Tres Montes, southern Chile, "even more perfectly conical than the famous sugar loaf of Rio de Janeiro. . . . It was a laborious undertaking, for the sides were so steep that in some parts it was necessary to use the trees as ladders. There were also several extensive brakes of the Fuchsia, covered with its beautiful drooping flowers, but very difficult to crawl through. In these wild countries it gives much delight to gain the summit of any mountain. There is an indefinite expectation of seeing something very strange, which, however often it may be balked, never fails with me to recur on each successive attempt. Everyone must know the feeling of triumph and pride which a grand view from a height communicates to the mind. In these little-frequented countries there is also joined to it some vanity, that you perhaps are the first man who ever stood on this pinnacle or admired this view." And then of course he went over the Portillo Pass and the Uspallata Pass.

In Tahiti where, incidentally, the conditions were such as to lead Captain Fitzroy and him to write and publish what was Darwin's first paper, published in South Africa, on the moral condition of Tahiti (but you wouldn't gather that from his notes)—the first thing he does is to get a guide to go up the highest point. On the way he says: "Beneath the ledge on which the dead tree was placed, the precipice

must have been five or six hundred feet deep; and if the abyss had not been partly concealed by the overhanging ferns and lilies, my head would have turned giddy and nothing should have induced me to have attempted it." And that wasn't the end, because as soon as he gets to Tasmania, Mount Wellington: "Another day, I ascended Mount Wellington; I took with me a guide for I failed in a first attempt."

I am sure everyone will agree that there is something which requires explanation in the case of this young man, who showed such hardihood and also such powers of resistance as he did during the voyage of the *Beagle*, not only in regard to the hardships of seasickness, cramped quarters and ship's food, but to the long periods ashore when at great danger and in extreme discomfort he went on expeditions which would, I think, daunt the courage of a great many people today; and then he comes home, and for the rest of his life, he suffers, first of all from fatigue—fatigue that prevents him from enjoying the ordinary social round of a young man who was rising in his profession, elected into the Royal Society at the age of thirty and who has the world at his feet and the entrée into any man of science's house and society. It is too much for him, he can't do it, because he is too tired, he suffers from frustration, he suffers from digestive discomfort, vomiting, and trouble with his heart. No physician has up till now been able to diagnose what was the trouble. But psychiatrists have speculated, and there are several views. I believe the one that was held in most favour was that as Darwin's father was an extremely strong character, and Darwin went on the voyage of the *Beagle* against his real wishes, he suffered from emotional hypochondria. This led him to be too tired to go out to dinner, too tired to undertake any geological excursion (and you must remember that until the year 1840, geology was the apple of his eye and natural history came second) and led to other symptoms which I won't repeat.

Now it so happens that within the last fortnight Sir Charles Darwin, Lady Barlow and myself have had the pleasure of receiving a visit from Professor Saul Adler, F.R.S., Professor of Parasitology in the Hebrew University of Jerusalem, and a world authority on tropical diseases. He is one of the very few people not living actually in South America who knows about South American tropical diseases, and he is a great student of Darwin. He noticed (and I think this is rather a reproach to all of us) that in the diary of the *Beagle*—'Journal of researches'—Darwin records that after passing over the Portillo Pass in the province of Mendoza, where he slept, probably on the floor, in a shack in the village of Luxan, he was subjected to a veritable attack (he says it could not be called anything less) by the Benchuca, the great black bug of the Pampas. It is an inch long, has no wings, is soft, and it crawls over the body like a flat postage stamp; but when it has sucked, it is like a large muscatel grape, full of your blood. Darwin was subjected to a veritable attack of the Benchuca and he had experienced the Benchuca also on other occasions in South America, as his diary shows. Now the Benchuca is *Triatoma infestans*, a very nasty member of the bugs; it is over 70 per cent. infected with *Trypanosoma cruzi*; *Trypanosoma cruzi* is the causative agent of Chagas's Disease, the province of Luxan is notoriously high in the percentage of its inhabitants with complement-fixation tests going up to 70 per cent., and this bug *Triatoma infestans* and *Trypanosoma cruzi* are also to be found wherever else Darwin went, Bahia, Rio de Janeiro, the Pampas, Chile, and Peru. Even today nobody knows very much about the clinical picture of Chagas's Disease, because it is variable. It produces fever, but while in some cases the trypanosome becomes encysted in the muscle of the heart, in others, and I refer to a Congress held only this year, it becomes encysted in the wall of the intestine. So there is a variable picture and nobody really knows what happens, but what we do know is that Darwin was massively exposed to infection by *Trypanosoma cruzi*. We know that he suffered, from the time he returned from the *Beagle* until he died, from trouble with his stomach and intestine, that he had a cardiac crisis in 1874 and that he died of a cardiac crisis in 1882. In view of what science, real science, can suggest of the effects of infection with this very nasty tropical disease, I am sure most of us will prefer to adopt the view that it is probable that he suffered from this, and hope that some day we may

get a little sign which would enable us to confirm it. For example, if only we knew that his face swelled at any time in South America, or that any part of him swelled immediately after a bite, that would be sufficient. I did find a place in the diary where Darwin describes a swelling in his arm and I showed it with great pride to Professor Adler, but he said, "Yes, that is very important, but there is no evidence that it was as a result of an insect bite," and so it is still not evidence. I am sure that this is an extremely important addition to what we had always been interested in, and have never known before.

Now, my Lord President, I must not keep you much longer. I shall only say that there are two things about the *Beagle* that I would like to add. One is that, thanks to Lady Barlow, I have been in touch with the great-granddaughter of Darwin's personal servant on board the *Beagle*. His name was Syms Covington, a boy, and his duty was to attend to poop-cabin, the cabin where Darwin and Stokes and King lived. Covington was detached from that duty and made personal attendant to Darwin who taught him to shoot, to skin animals, to collect them, to label them, to catalogue them and to pack them; and it is because of the help that Syms Covington was able to give him that his collections were as good and as rich as they were, and if it had not been for that, it might well have been that he could not have made the collections in the Galapagos Islands which led him to that great meditation which is keeping us all on our toes even today.

The voyage of the *Beagle* which ended at Falmouth (really it didn't, it ended in the Thames: Darwin got ashore at Falmouth but the *Beagle* came round and was paid off in the Thames) was not the last. She was commissioned again and went to the Australasian region where there was a great deal of surveying to do around the coasts of New Holland, and in one of the bays on the north side of that great continent the officers found a very interesting harbour into which they went. There was a point which they climbed, the geology of which was so interesting that they had no hesitation in naming that piece of water Port Darwin. And, if I may just conclude on that note, whatever either the Royal Geographical Society or the Alpine Club may feel uneasy consciences about at not having done while he was alive, there is in the Tierra del Fuego a mountain that is forever Darwin.

PROGRESS AND GEOGRAPHICAL SIGNIFICANCE OF THE KARIBA DAM

W. H. REEVE

SINCE THE LATTER HALF OF 1955 the popular imagination both inside and outside the continent of Africa has been captured by the immensity of the project to dam the flow of the mighty Zambezi River for the purposes of producing hydro-electric power. The part of Central Africa now known as the Federation of Rhodesia and Nyasaland is particularly rich in rivers of a magnitude adequate for such purposes. It was inevitable that, with the march of time and progress, men should eventually be compelled to realize that these vast, untapped, natural resources of water and water-power could not for ever remain unharnessed. The conception of the Kariba project stems from such a realization, accelerated by the pressing need for economic development of these relatively virgin territories, rich in mineral and agricultural potential. No less urgent was the need to provide for the economic progress and general improvement in the standard of living of millions of indigenous inhabitants of the Federation. Although agricultural pursuits are able to absorb many, it remains for the establishment and multiplication of industrial enterprises to absorb the great majority and to provide them with the means to improve their economic and social status. The provision of ample, and cheap, electric power is a necessary corollary.

Geographical environment of the Kariba Dam

The Zambezi River rises in the Mwinilunga district of Northern Rhodesia, flows immediately into Angola and through it for 200 miles before re-entering Northern Rhodesia. From the source to the Victoria Falls is approximately 800 miles, and from thence to the sea a further 900 miles. For 930 miles, the river flows entirely within Rhodesian territory and for almost half of this distance it forms the boundary between Southern and Northern Rhodesia. The gorge named Kariba (which is a generic native name meaning "gorge", so that it is, in fact, tautological to speak of "Kariba Gorge") occurs some 240 miles downstream of the Victoria Falls and about a mile below the confluence of the Zambezi with the Umniati (or Sanyati) River. The site of the dam lies rather more than a mile downstream from the infall of the Umniati (Fig. 1).

From the upstream entrance to the 15-mile-long gorge, the Zambezi flows generally northwards for 40 miles. At the dam site, the river bed lies at approximately 1200 feet above mean sea level and, on either bank, the country rises precipitously to an altitude between 2500 and 2800 feet. On the Northern Rhodesian side, an even greater altitude is reached more quickly than on the southern side, and is more heavily dissected, one of the highest points within 3 miles of the river being Balale at 3191 feet. This country, on both sides of the river, is thickly clothed with "bush," mainly consisting of the *Brachystegia-Isoberlinia* tree association, but mainly *B. boehmii*. Away from the gorge there are variations, according to changes in geological formation, to *Uapaca* and *Colophospermum mopane*. The first-named association is, in general, found on areas underlain by crystalline rocks of the pre-Cambrian formations, the last two, on those parts underlain by sediments of the Karroo System (Permo-Carboniferous to Jurassic).

The completed dam wall, June 1959; Lake Kariba forming upstream

By courtesy of the Federal Information Department

By courtesy of the N. Rhodesia Information Department

Bush-clearing by steel sphere and anchor-chain

By courtesy of the N. Rhodesia Information Department

The rising lake engulfs a Tonga village

The hydro-electric project

Brief history.—The possibilities of development of hydro-electric power at Kariba (and other points on the Zambezi), were first considered in 1925 by the Southern Rhodesia Government, and a report was produced by its Hydrographic Engineer on water-power resources of Southern Rhodesia. Between that date and 1946, a number of investigations were made, when it was realized that it would be

Figure 1

essential to provide for a substantial source of power for the development of industries in Southern Rhodesia and for the expansion of the Northern Rhodesia copper-mining industry. In 1946, a Hydro-electric Power Commission was appointed, with representatives from both countries and, between then and 1951, a substantial sum of money was spent investigating the possibilities of hydro-electric development on both the Zambezi and Kafue Rivers. After considerable controversy, the Government of the Federation of Rhodesia and Nyasaland, which had come into existence in October 1953, decided in favour of development at Kariba.

Progress.—Construction work commenced in October 1954 on a progressive plan strictly related to the seasons of high and low water on the Zambezi during the ensuing four years. Details of the plan and the constructional features have been

adequately described elsewhere[1, 2] and it is not with the engineering aspects of the work at Kariba that this account is primarily concerned. Very briefly, however, it may be said that it proved possible to adhere to the general programme and, in spite of considerable set-backs due to the exceptionally high flood conditions in the rainy seasons of 1956–7 and 1957–8, the dam wall was completed to full height by the first week in June 1959, some fifteen months ahead of schedule.

Significance of the dam

Hydro-electric power production.—At completion, a massive wall of concrete in the form of an arch dam, 400 feet high (35 feet higher than St. Paul's Cathedral) has been erected across the Zambezi River. It has been described as "Africa's greatest mass of masonry since the Pharaohs built the Pyramids." The effect of this dam will be to impound behind it a lake containing 140,000,000 acre-feet of water, or four and a half times the amount impounded in the Hoover Dam in the U.S.A.; the latter is at present the largest man-made reservoir in the world. It is expected that the lake will extend 175 miles upstream with an average width of 12 miles and a maximum width of 20 miles. The greatest depth of water will be about 390 feet. The impounding of water commenced in November 1958 and, at the time of writing, the level behind the dam has risen approximately 274 feet and the lake now extends over 100 miles upstream. The exact time it will take to fill the lake to full operating level cannot be calculated, but if the rainfall is average over the next two or three years, the required level should be reached by 1963. However, intervening years of drought or flood could retard or advance the filling process by as much as two years.

The flow of the Zambezi varies between about 15,000 and 200,000 cubic feet per second and, of course, one of the main effects of the dam and the creation of the lake will be to regulate the flow of the river over the last 800 miles of its course. Evaporation will take its toll over the lake surface, but this should amount to not more than 10 per cent. of the total flow. Adding a further 6 per cent. that will pass over the spillway, it is clear that 84 per cent. of the total flow will be available for the generation of electric power. It will, in fact, be possible to draw continuously on the flow to the extent of 39,000 cubic feet per second. In terms of electrical energy, this is equivalent to 7,650,000,000 kWh per year.

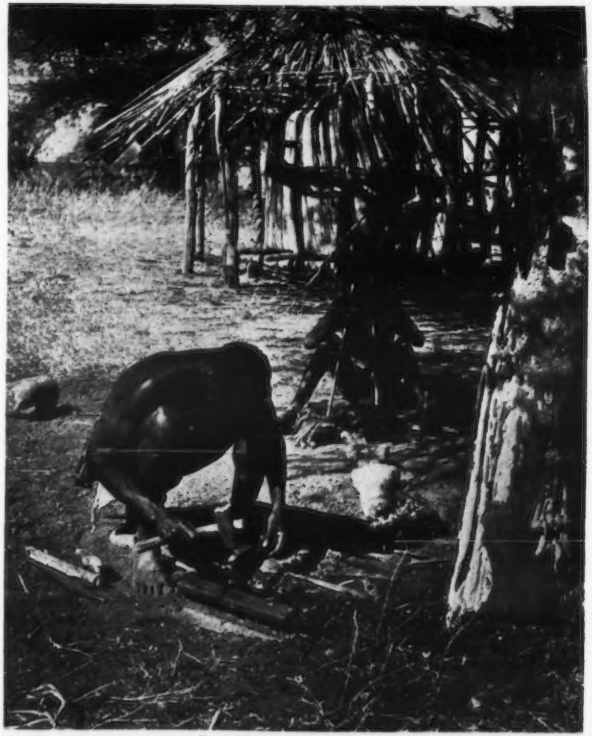
The installed output of the first completed stage of power development will be 600 megawatts. Subsequently, the final stage will involve the building of a second power station of equal size on the Northern Rhodesian bank, when the full installed capacity will be 1200 megawatts. A total of 935 miles of transmission line will carry the power from Kariba northwards to the central switching station for the Copperbelt at Kitwe, Northern Rhodesia, and to the Umniati and Norton power stations in Southern Rhodesia. The two latter places will be linked with Salisbury and Bulawayo. The full transmission development will, of course, take a number of years to complete and it is expected that it will be 1972 before full development is reached. Because of the enormous distances to be covered by the transmission lines and, therefore, to reduce the voltage loss, the transmission voltage will be 330,000 volts. The conductors are to be of steel-cored aluminium throughout, a point that may appear surprising when it is realized that they are to be used in a country now holding second place in the ranks of world copper-producers. Although other factors concerned with tensile strength of the conductors may have been involved, it is thought that the all-time high price of copper (more than £400

[1] Anderson, Duncan L., "Hydro-electric power for the Federation," *Optima*, pub. Anglo-American Corporation of South Africa, Limited, Johannesburg, 6, *No.* 2, June 1956.

[2] "Kariba Bulletin," in successive issues of *Rhodesian Industrialist* since September 1955.

By courtesy of the N. Rhodesia Information Department

Women of the Bawe tribe



By courtesy of N. Rhodesia Information Department

A Tonga blacksmith fashioning a spearhead; goatskin bellows in background

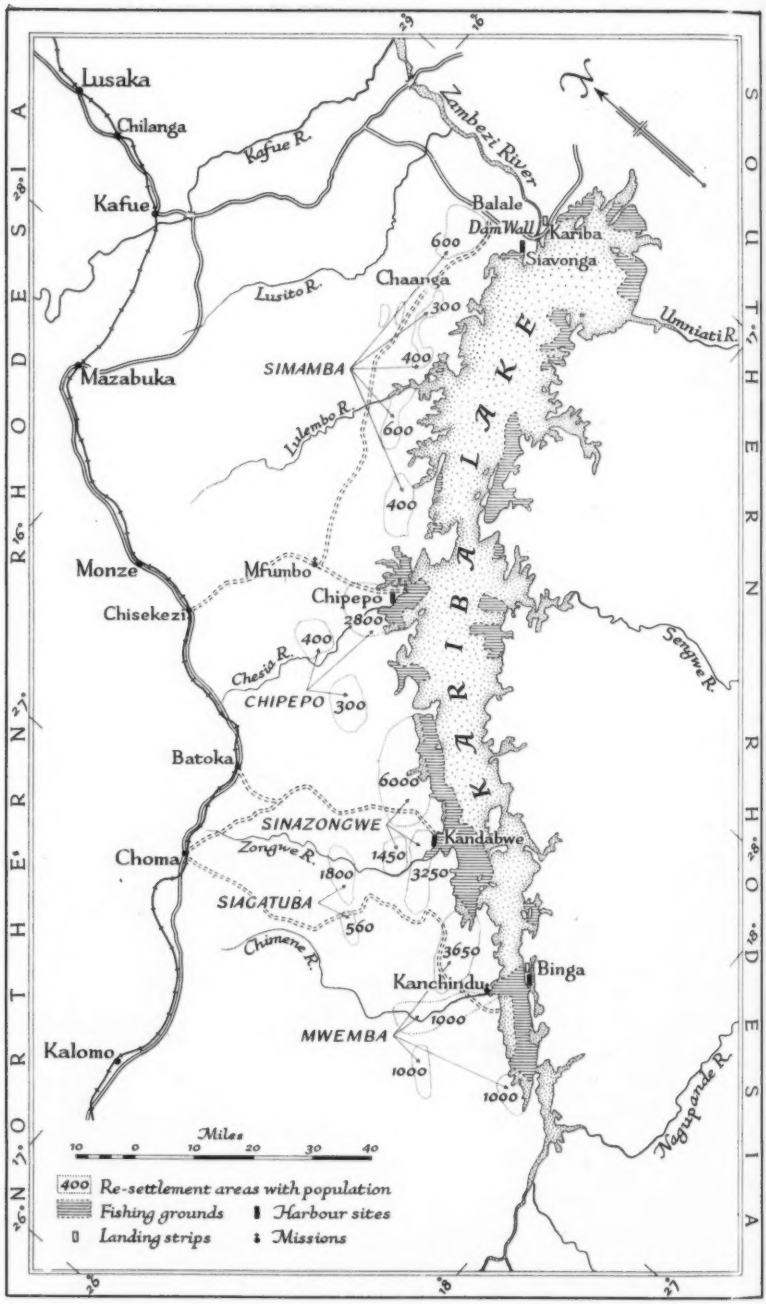

Lusaka
Chilanga
Kafue R.
Zambezi River
Kafue
Balale
Dam Wall
Kariba
Siavonga
600
Chaanga
Lusito R.
300
Umniati R.
SIMAMBA
400
Mazabuka
Lulembo R.
600
400
Monze
Mfumbo
Chipepo
Chisekezi
2800
400
Sengwe R.
Chezia R.
CHIPEPO
300
Batoka
6000
SINAZONGWE
Kandabwe
Choma
Zongwe R.
1450
1800
3250
SIACATUBA
560
Chimene R.
3650
Binga
Kanchindu
1000
MWEMBA
Kalomo
1000
1000
Nguapande R.
KARIBA LAKE
SOUTHERN RHODESIA
NORTHERN RHODESIA
Miles
10 0 10 20 30 40
400 Re-settlement areas with population
Fishing grounds
Harbour sites
Landing strips
Missions

Figure 2

per ton) at a time when costs of the scheme were being carefully calculated in detail, was a contributory factor in this decision.

Effects on industrialization.—In order to form any estimate of the effect of the Kariba scheme on the potential industrialization of the Federation, it is necessary first to look at the existing background of its economy. Thus far, the prosperity of the three constituent territories has been based on their agricultural and mineral resources and it seems clear that, for the future, the Federation must look for its continued development and well-being to a fuller use being made of these natural assets. Undoubtedly, the most important of the mineral resources so far has been the copper of the Northern Rhodesia Copperbelt. Other copper deposits have been discovered and proved in Southern Rhodesia but, as yet, these are insignificant by comparison. In the latter country, gold, chrome, asbestos and coal have also contributed in material terms to the economy of the territory and, under favourable world market conditions, will continue to do so. There is, in addition, a number of other minerals, including lead, zinc, vanadium, cadmium, tungsten, beryllium, lithium, mica, iron pyrites and other iron ores, manganese, fluorspar, limestone, uranium and niobium ores, the working of which is contributing, or is likely to do so in future, to the expansion of the Federation's income. The total value of mineral production, for instance, in the Federation for the year ending December 1958 was £102,557,000 and the total value of all minerals produced up to that date, since mineral production began, is estimated at approximately £1,491,582,000.

Alongside the production of minerals is a healthy agricultural industry which includes the production of tobacco, maize, cotton, tea, beef cattle and dairy products. Apart from mining, primary industry, mainly confined to Southern Rhodesia, is limited to the manufacture of iron and steel, but other manufacturing activities produce cement, processed foods, textiles and other goods. While secondary industries have already made their appearance in Southern Rhodesia, it is clear that, in order to support its rapidly-growing population of all races, but particularly African, and to enable the latter to improve markedly their economic and social standards, there must be continued industrial expansion. In turn, this expansion will rest largely upon provision of an ample supply of electric power at reasonable rates. At the present time, most of the electric power supplied is generated by thermal stations. This, in turn, calls for the development of transport lines for fuel. In a part of the world where the industrial and mining development tends to occur in isolated areas separated by long distances, the existing communications and transport systems are strained to the utmost to cope with essential supplies. When it is remembered that all the long-distance railway communications in the Federation, or to the Federation from outside, are single-line tracks, the difficulties inherent in movement of fuel or goods will readily be appreciated. The total rail distance from the Wankie colliery to the centre of the Copperbelt mining area, for instance, is 600 miles. It is obvious, therefore, that hydro-electric power has a special advantage in countries such as the Federation of Rhodesia and Nyasaland. It is confidently expected that the production of power from Kariba will be the means of accelerating industrialization.

Sociological consequences.—Important and far-reaching though the effects may be of hydro-electric power generation on the industrial economies of the territory, there are other directions in which the building of the Kariba dam will have equally interesting and more immediate consequences. Let us, for a time, look at the other results of creating a lake of the size of Kariba which will cover an area approaching 2000 square miles (see Fig. 2). That part of the floor of the Zambezi which is being slowly inundated has, for an uncertain, but large, number of generations, been occupied by tribes of people allied to the Tonga. In the north-east

section of the valley, they are commonly known as the Valley Tonga; in the more extreme south-west, they are the Bawe. The mid-Zambezi valley is a rift valley with the high plateau on either side towering more than 2500 feet above the flood-plain of the river and cut off from it by an intervening zone of intensely dissected country generally known as the "Escarpment," on which slopes are commonly precipitous. Consequently, the Batonga of the valley have tended to remain isolated and they are, today, in general, one of the most primitive of Northern Rhodesian tribes, living in the later Iron Age and cultivating with the hoe. Mostly, they have inhabited the country nearest the river where the annual floods of the Zambezi have provided them with new soil on which to grow their staple crop of maize or kaffir-corn. Never over-energetic, they have periodically been reduced to starvation when the Zambezi has failed to flood its banks and crops did not mature. Although river dwellers for so long, they have apparently, with rare exceptions, never become a race of fishermen. One reason advanced for this defection is the dearth of hardwood trees in the valley, of a size from which enough dug-out canoes could be constructed. Now, owing to the flooding of their former lands, they have had to be moved to safer ground fringing the upper limit of inundation. They will become lake-shore peoples. More than 29,000 people have been moved, not without opposition at first, but much more readily latterly as they have noted the waters of the lake inexorably encroaching on their former homelands. With their entry into new country, it is as if they had entered a new life. Not only are dwellings and villages being built to a higher standard but, although the traditional methods of cultivation still remain, improved methods of agriculture are being encouraged and adopted, and it is reported that there is now a continued demand for both oxen and ploughs. Furthermore, with Government assistance and advice, a greater diversity of crop-growing is engaging the attention of these people. At Kandabwe, in addition to the former staple crops, paw-paws, citrus, bananas and coconuts are being experimentally planted. In the Siagatuba area, Turkish tobacco-growing was being encouraged but, owing to relatively poor fertility of the land, the Africans settled initially at Siagatuba have now been moved nearer the plateau in the Kalomo area.

It is of considerable interest to note that, in pursuance of the policy of tse-tse fly control, resettlement at Kandabwe has almost completed eradication of the fly there. The creation of these new settlements has brought other advantages also. Prior to the mass movement of people to their new homelands, the Governments concerned took steps to provide adequate water supplies, and the people are now provided with boreholes or wells equipped with hand-pumps. Cement-lined brick tanks of up to 10,000 gallons capacity, and troughs, serve the needs of their stock. The presence of a lake of relatively still water in which fish supplies are steadily increasing, has also claimed their interest. The Game and Fisheries Department of the Northern Rhodesia Government (on behalf of the Kariba Lake Coordinating Committee) is being responsible for stocking the lake with bream bred in the fish ponds of that Department at Chilanga. It is intended to put in 40 tons of fingerlings over the next four years and, so far this year, more than 7 tons of these young fish have already been put into the lake, mainly in the Sanyati basin on the Southern Rhodesian side. Those areas of the lake which are to constitute the fishing grounds have been cleared, or are still being cleared, of all bush up to a maximum depth of 60 feet before the rise of the lake waters. Nearly a quarter of a million acres are to be cleared for this purpose in seven areas on both sides of the lake. Various bush-clearing methods have been tried with greater or less success. The latest, probably the most expensive but certainly the most effective, is by means of enormous

(8-foot diameter) steel spheres towed on battleship anchor-chain by large caterpillar diesel tractors.

There is growing evidence of the improvement in the health of the Africans moved to the new areas, although prejudice and superstition in these people are difficult obstacles to overcome and many are still reluctant to seek skilled medical advice either for themselves or their children. Often, they abstain from doing so until so late a stage that even the most skilled assistance is powerless to save the patient, who dies, and antagonism is increased because medical aid failed to do what was expected of it under impossible circumstances. However, there has been considerable improvement in this respect and it is clear that the introduction of fish into the diet is already having a marked effect. For various reasons, parts of the lake already formed are yielding extraordinarily good catches, and the African in those parts is enthusiastically taking advantage of the situation and, as a result, taking a much more lively interest in fishing. Many requests for fishing equipment, particularly nets, are being received, and even for metal boats. Fish guards having trained at Chilanga, Northern Rhodesia, are being posted to resettlement areas to act as instructors, and the people generally are proving extremely receptive. An interesting sidelight on the overcoming of the deep superstition prevailing among these Africans in this connection, is shown up vividly in a report from a correspondent of the *Sunday Mail* who, on 14 June 1959, wrote:—

"In the warmth of the afternoon, the older men of the tribe were resting contentedly, sleeping off a huge meal while the women kept an eye on still more fish kippering over the woodchip fires. Boys and girls and babies of the tribe were sleek and chubby. . . . 'The Lake has been good to us, an old man said. 'We were afraid when they dammed the river the fish would be frightened and go, but now we have this great lake and there are more fish than ever before.'"

Communications and amenities.—The development of the lake shore is the responsibility of the Kariba Lake Coordinating Committee, a body set up in December 1957 to advise the Federal, Southern and Northern Rhodesia Governments on coordinated development of the lake and its littoral. Expenditure is met by the three Governments in equal proportion, a sum of £3,000,000 having been allocated for this purpose. The projects envisaged are centred on three broad groups, viz. fisheries, lake water transport and tourism. Already, the building of the dam and movement of people has resulted in the conversion of indifferent roads into all-weather roads as, for example, from Batoka and Chisekesi on the Northern Rhodesia plateau, to Sinazongwe and Chipepo respectively; and of bush tracks in the valley into good, dry-weather roads. Eventually, Kariba itself will be linked to Salisbury and to Lusaka by a tarmac road. The lake itself will offer the principal line of communications through the valley and a number of private companies are already interested in the development of water transport.

Three township areas, at Kariba, Siavonga and Sinazongwe, will be built around harbours, with a fourth harbour at Binga on the south bank. These are to be developed as centres for commercial fishing, lake transport and tourism, although it is unlikely that commercial fishing will be permitted before 1963 when stocking is due to be completed. On the Northern Rhodesian side, a plan is being prepared to provide sites for residential and trading purposes, camping, landing stages, boat-yards and a hotel or motel for public purposes. The comparative proximity of this vast area of water to towns like Bulawayo and Lusaka, which are two to three full days' rail journey from the nearest sea coast, will be an inestimable boon. An additional development planned is the spanning of the lake at its western end by a ferry between Kanchindu and Binga. This will give direct access to a small lake off Lake Kariba, which is likely to constitute a good tourist attraction. The Zambezi River

here flows through the Devil's Gorge, scenically very attractive, and the fishing in this small lake is likely to be second to none elsewhere.

Other aspects.—From a climatic point of view, it is not thought likely that the creation of even this large expanse of water will have any other than a purely local effect. Normally, this part of the Zambezi valley is a place to be avoided in the months of October to February. It is probable that the oppressive heat of these months, when the temperature commonly reaches a level of 105° to 110° F. in the shade, will be offset to some extent around the shores of the lake by a cooler breeze. It is not thought likely, however, that this effect will extend very far inland from the shoreline. The winter months, on the other hand, are characterized by fairly stiff breezes which may whip up the waters of the lake into sizeable waves. Already, waves of up to 10 feet have been encountered on the part already flooded.

This portion of the Zambezi valley is affected by faulting. The movements are originally of very ancient date, possibly ranging as far back as pre-Cambrian times, but renewal of movement along these ancient lines occurred in Karroo or post-Karroo times. One such major fault runs parallel with and near to the bed of the river in the vicinity of the dam site. The country flanking the river on both sides is traversed by a complicated pattern of faults. There is conjecture as to what effects may be caused by the loading of the earth's crust at this site, with the weight of the enormous volume of water contained in the Kariba Lake. It is known, for instance, that when the Boulder Dam was built in the U.S.A. the weight of water caused the earth's crust to "bend." At Kariba, the Director of Federal Trigonometrical and Topographical Surveys has initiated a study of the behaviour of the earth's crust, and acknowledgement is due to him for the following details.[1, 2]

Very accurate levels have been established round the lake at permanent high-water-mark, and permanent bench marks were left at approximately mile intervals; these will be available in future to provide accurate levels. The Director's report states: "It was also planned that these marks would give a clear indication above high-water-mark, of the extent of any subsidence of the earth's crust which might occur once the lake had filled, when selective re-levelling will be undertaken. In order to determine the amount of subsidence on the floor of the future lake at points where the maximum depths will occur, special levelling has been carried out." This levelling involves two islands in the Sanyati basin which have been levelled-to, and a nest of bench marks established on the highest points; and special level-platforms of steel plate erected on rock in this basin, at future depths of 240, 180 and 140 feet, the tops of the platforms levelled-to. It is hoped to use these level-platforms as targets for subsequent soundings when the lake is full.

In order to record earth tremors during the filling of the lake, three temporary recording stations will be set up: at Kariba itself, at M'Fumbo Mission and at Chaanga. The recorders will be single-component Willmore seismographs controlled by crystal quartz clocks.

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[1] 'Annual Report of the Director, Federal Department of Trigonometrical and Topographical Surveys,' Salisbury, 1958.

[2] "Memorandum on survey operations in the Kariba basin for future development and geophysical data" (unpublished).

AN HISTORICAL GEOGRAPHY OF ENGLAND: TWENTY YEARS AFTER

H. C. DARBY

'AN HISTORICAL GEOGRAPHY of England before A.D. 1800' was first published by the Cambridge University Press in 1936. The preface describes it as "in a sense, experimental." That it ended at 1800 had no great significance; this date was chosen largely because the geography of the nineteenth century had recently been covered in certain chapters of Sir John Clapham's 'An economic history of Modern Britain.'[1] At any rate, 1800 was a convenient date, and we seemed to have lacked either the equipment, or maybe the resolution, to go beyond it. The preface also says that, quite deliberately, no attempt was made to provide "a philosophical introduction." I well remember thinking over this and, for better or for worse, coming to the conclusion that the time for writing a methodological essay had not yet come. All this was over twenty years ago, and I think, or at any rate I hope, that we now can view the experiment objectively. This seems a convenient moment for stock-taking, and not only for stock-taking but for a review of the tasks that have yet to be accomplished before a well-balanced and satisfying 'Historical geography of England' can be written. While "twenty years" or so is mathematically correct, some five or six of those years saw our minds occupied with other matters, and this must be remembered when we think of what has been done since. After this interval of time, two lines of thought suggest themselves—the first concerned with the method or the design, the second with the material or the sources that are available.

The design.—The method of cross-sections has much to be said in its favour. It is true that we are unable to rely upon primary field-work, but methodologically there is, or should be, no basic difference between a view of the geography of England today and one of England in, say, 1500. Macaulay's famous Third Chapter of 1848[2] has been followed by a number of cross-sections, mainly by historians—F. J. Haverfield's account of Roman Britain,[3] the brief descriptions of England in the early eighteenth century by G. M. Trevelyan[4] and G. D. H. Cole,[5] those of Britain in 1820 and 1886 by J. H. Clapham,[6] and that of England in the seventeenth century by David Ogg.[7] Then, more recently, A. L. Rowse in 'The England of Elizabeth,' asked the question: "If we would think back to what the face of the country looked like then, what are the chief differences we should notice?" A number of chapters seek an answer to this question and, in so doing, give us a vivid reconstruction of the geography of England in the later years of the sixteenth century.[8] At the same time, S. T. Bindoff was describing how Tudor England "wore an appearance very different from that which the name now conjures up in our minds.[9] And not long after J. D. Mackie, in his study of the earlier Tudors, devoted a chapter to "The face of the country."[10] In addition to these reconstructions of the sixteenth, seventeenth, eighteenth and nineteenth centuries, there have been others more restricted in scope and concerned with more limited localities.

These cross-sections were written to meet specific needs. They can be discussed from this or that point of view, but the methodological problem they all present is a relatively simple one. An individual cross-section of the geography of a past period, if it aims to be explanatory and not merely empirical, should take into consideration the relevant circumstances of earlier times in the same way as should an

account of the geography of the present day. But, on the other hand, when we contemplate a chronological series of cross-sections, we are at once faced with more complicated considerations. Two very different methods of treatment can be envisaged. If, on the one hand, each cross-section in a sequence aims at being a balanced geographical account, compounded of description and explanation, there will, of necessity, be much repetition and varying degrees of overlap as each cross-section ranges backwards to satisfy its own needs. If, on the other hand, each cross-section is limited strictly to its own contemporary materials, a valid criticism might be that the sequence constitutes a series of static pictures that ignore the process of becoming. They will, of course, reflect changing geographical values by the mere fact of following one another, but only by implication and inadequately. Between these two extremes, a variety of compromise is possible, and it is interesting to see how fellow-workers have grappled with this problem of presenting a succession of dissolving views.

One can, for example, base each cross-section directly on the one preceding it. This is very suitable when the intervals between the cross-sections are small, and/or when the area considered is so restricted as to change almost as a unit. Many American studies in sequent occupance are of this nature; such is S. D. Dodge's "Bureau and the Princeton community" with its five transects of a characteristic Corn Belt township from 1829 onwards.[11] In a sequence covering a larger and more varied area, a cross-section has frequently to embody in itself, either by allusion or in separate passages, an account of the changes since the time of the preceding cross-section. This is so in K. B. Cumberland's four views of New Zealand between 1780 and 1881[12]; the account of 1838 contains much retrospective material to explain the changes since 1780; that of 1853 likewise glances back more than once over the years since 1838; and, in turn, the cross-section of 1881 is accompanied at appropriate points by reviews of changes since 1853. In brief, each cross-section seeks to explain itself; but, looking at the four cross-sections as a whole, we see that "historical perspective" or narrative has been subordinated to the main theme of presenting views of past landscapes.

There are studies, however, that are compounded as much of narrative as of description. They have to be, because their successive views cover such large periods of time and such great stretches of countryside. Thus Gradmann's classic account of the development of the landscape of Central Europe is organized into five periods; one of these spans 500 years, and another even 750 years.[13] In contrast to this, Kretschmer's study of Central Europe, with its emphasis upon political change, uses horizontal cross-sections in a much stricter sense; these are tied to the circumstances of five definite years—1000, 1375, 1550, 1650 and 1700.[14] Among the many other German studies, Bodo Knüll's account of Germany in the Middle Ages adopts yet another method of combining narrative and description. The first nine chapters discuss the history of the change of individual elements in the scene—vegetation, mining, settlement and roads, for example—and then a last chapter summarizes the material in terms of three horizontal sections.[15]

The problem of combining explanation and description has been solved in yet another way by J. O. M. Broek in his study of the Santa Clara Valley.[16] Here, four cross-sections are separated by three studies of the social and economic forces that led to successive changes in the landscape. The relevant chapter-headings are as follows:—

The primitive landscape.

5. The Spanish-Mexican period: the social-economic determinants.

6. *The landscape in Spanish-Mexican times.*
7. The Early American period: the social-economic determinants.
8. *The landscape in the Early American period.*
9. The Recent American period: the social-economic determinants.
10. *The present landscape.*

This device of formally separating the explanatory "social-economic determinants" from the description of the landscape at each period serves not only to furnish a genetic explanation of each landscape but also to provide connecting links between the successive views. It is a most interesting methodological approach.

In all these examples, the cross-sections succeed one another in time. But there are some other studies of selected aspects of the geography of regions in which the interesting experiment of going backwards in time is attempted, and in which the cross-sections follow one another in reverse order. Such is the treatment to be found in the account of part of Switzerland by H. Dörries,[17] and in that of the Middle Garonne district by Pierre Deffontaines.[18] This method of approach implies much more than—so to speak—a mere rearrangement of chapters. There may well be a case for describing a countryside before explaining how it came to be, but, on the other hand, it is not easy to keep on doing this in a retrospective sequence of cross-sections.

In the light of this hasty glance at other work, we can now turn back to 'An historical geography of England.' The preface speaks of "the reconstruction of past geographies" and of "a sequence of cross-sections taken at successive periods." The volume does contain many of these but, on the other hand, some chapters are concerned not so much with cross-sections as with the events and developments that produced changes—the Anglo-Saxon settlement, the Scandinavian settlement, the draining of the Fens, the growth—growth, notice—of London. The inclusion of these narratives can be vigorously defended, but they cannot be called cross-sections. The form these chapters took was dictated partly by the nature of the periods or problems with which they were concerned, and partly by the nature of the available source material. Turning to the cross-sections themselves—those chapters that attempt to fulfil the promise of the preface—we find that various asides and cross-references attempt to knit them together.

Were one to plan a new cross-sectional 'Historical geography of England' there might well be a case for adopting six cross-sections as indicated below. Possibly one might add a seventh dealing with 1900. These dates seem to be indicated by the march of the developing landscape, and by the nature of available sources. Between the cross-sections there might be intervening chapters dealing with the economic changes that gave successive landscapes a new look.

1. *The prehistoric background.*
2. *Roman Britain.*
3. The Anglo-Scandinavian settlement.
4. *Domesday England.*
5. Economic change in the early Middle Ages.
6. *England in the early fourteenth century.*
7. Economic change in the later Middle Ages.
8. *England in 1600.*
9. The "Improvers" and their work.
10. *England in 1800.*
11. The changes of the early railway age.
12. *England at mid-century (1850).*

The period between the end of Roman rule and the year of the Domesday Inquest was one of great fluidity, and the sources are so fugitive, that it is difficult for the pen to catch the scene before 1086. Yet it was a formative period of the greatest importance for the landscapes of all subsequent time. The village-sites those Anglo-Saxons and Scandinavians chose are very largely the sites of today. Where, in Hertfordshire, Wicga established his "tun," or homestead, there stands Wigginton today, and where Putta made his "ham" nearby, there stands Puttenham. And then in the eleventh century, after the swirl of the great movements had subsided, we can survey the result through the eyes of the Norman clerks. No later invasion of peoples modified the Anglo-Scandinavian pattern, for the Norman Conquest was the transposition of an aristocracy and not a folk movement of new settlers on the land.

But changes did not come to an end with the arrival of the Normans. The countryside was used and cleared and altered, and towns grew and prospered. Yet it was an expansive movement that did not continue uninterruptedly into modern times. In places it slowed down; in others it ceased; and in yet other places the frontiers of cultivation must even have retreated, and the populations of towns may even have declined. Certainly in England, as in most of Western and Central Europe, medieval agrarian and commercial effort had reached a maximum by 1300, and the great age of expanding arable and trade was succeeded in the fourteenth and fifteenth centuries by one of stagnation and recession.[19] During the hundred years between 1350 and 1450, the decline was especially marked. The early fourteenth century is therefore suggested as a suitable moment for another view of England. It is early enough to avoid the full impact of the recession, and it is late enough to include the taxation assessments which can be made to serve as a framework for considering the country as a whole (see p. 152 below).

The recession became merged into the flowering of the sixteenth century, a flowering reflected in the works of Leland and Camden, to say nothing of the new county topographers. Like Michael Drayton, in the 'Polyolbion,' they all sang of "Albion's glorious isle," and in so doing, provided us with material which makes 1600, rather than 1500, a convenient moment for another cross-section. From 1600 to 1800 were the years of the "Improver." The clearing of the wood might have been the great epic of the Middle Ages, but there were other epics to come—the draining of the marshes, the reclamation of heathlands, the enclosure of the arable, the spread of landscape gardens, the making of canals and the beginnings of the seats of industry. In the words of James Thomson, writing in 1730, "Heavens! What a goodly prospect spreads around."[20] Not only was the countryside changing, but the written evidence about it was increasing prodigiously. With the Reports of the Board of Agriculture from 1793 onwards, with the agricultural statistics of 1801,[21] and, not least, with the first Census of 1801, the year 1800 or so leaps to mind as a possible time for another survey. After 1800, the choice is open. The year 1850 seems suitable because of the existence of the Tithe Survey and of the county Prize Reports of the Royal Agricultural Society about this time. Mid-century, on the eve of the Great Exhibition, is a convenient date.

The result would be six cross-sections[22] and five connecting narratives, and to these could be added an introductory chapter dealing with pre-Roman Britain. This is not to suggest that there could not be other cross-sections. Of course, there could be, and perhaps more appropriate ones. Nor should the "horizontal" be set against the "vertical" method. Both have entered into this pipe-dream of a scheme, and both are permissible and may be desirable.[23] What is more, in the

attempt to grapple with reality, there are many ways of applying either view or a combination of them.

The sources.—The last twenty years have seen both increased interest and great advances in archaeological investigation. At point after point our knowledge of pre-Saxon Britain has been enriched. Let me give only one instance—the suggestion that the Breckland heaths "had their origin in Neolithic forest clearance."[24] Obviously, here is much that is relevant to our own studies of changing landscapes. Then again, the publication of the third edition of the Ordnance Survey 'Map of Roman Britain' (1956) has provided an enormously increased body of fact upon which to base a cross-section. Some idea of the extent to which these early ages have left vestiges of themselves upon the present landscape may be seen from the Ordnance Survey 'Map of Ancient Britain' (1951) which is described in the subtitle as "a map of the major visible antiquities of Great Britain older than A.D. 1066." These relict features, of course, are far from constituting the only influence of these early years upon our landscape.

The publication, in 1939, of the Ordnance Survey 'Map of Britain in the Dark Ages' came too soon to add much new factual information to the chapter on the Anglo-Saxon settlement. Amongst the material that has accumulated since then, the continued work of the English Place-Name Society is outstanding. An especially welcome feature is a map showing the parish names of Scandinavian origin,[25] and Isaac Taylor's map of as long ago as 1863 has at last been superseded.[26] Full use, however, has not been made of this array of place-name evidence for geographical purposes. It is true that a number of geographical studies have used place-name evidence in connection with their particular themes,[27] but there seem to be relatively few published English studies[28] comparable with some that have appeared in French or German—comparable with, say, Albert Dauzat's use of place-names to reconstruct what he calls "the primitive aspect" of Beauce,[29] or with the use of place-names in the studies of settlement made by A. Bach[30] and G. Niemeier.[31] Furthermore, the evidence of Anglo-Saxon charters in "reconstructing the shape and features of the countryside in late Saxon times" has, in the words of E. M. Jope, "been very little attempted."[32] Such evidence would certainly repay investigation, and throw light upon the early economy and landscape of this or that region; but for a general, and relatively uniform, survey, there is nothing before King William's Inquest of 1086.

This is not the place to discuss the evidence of the Domesday Book. A sentence on p. 229 of 'An historical geography of England' says that "much statistical work will have to be done before the full geographical contribution of the Domesday Book has been extracted." The end of the Domesday project is not yet in sight, but it is not far below the horizon.[33]

After the eleventh century comes a long interval before we encounter another view of England that is so extensive and so detailed. In many ways, the period between the Domesday Inquest and the topographical writings of the Tudor Age is the most difficult that confronts the historical geographer of England. The sources, on the one hand, are numerous and varied, but, on the other hand, they are so often fragmentary and intractable. Amidst the variety we might, in the first place, concentrate our attention upon one great body of material, the numerous taxation assessments that were levied for this or that purpose, frequently for military expeditions.[34] A frequent request was for a ninth or a tenth or a fifteenth, or some other proportion of "movable goods" (crops, stock, etc.), as distinct from "real" or fixed property (houses, land). The records vary in their detail, in their reliability and also in the degree to which they have survived. A brief account of

some of them was given as long ago as 1888 by Thorold Rogers in an essay on "The distribution of wealth in England at different epochs."[35] More recently, in 1950, E. J. Buckatzsch discussed them generally in an article entitled "The geographical distribution of wealth in England, 1086–1843.'[36] But before the appearance of this latter paper, R. A. Pelham had already shown what light they could be made to throw on the geography of medieval England[37]; and since 1936 others have also made interesting experiments in this field.[38]

The information these assessments contain requires critical handling; it needs to be subjected to the closest scrutiny to see to what extent particular assessments can be used, and over what area. One important drawback to the use of Lay Subsidies is the almost complete exclusion of the "movable goods" of the Church. To what extent this affects the validity of Lay Subsidies as indicators of regional prosperity needs further investigation. Furthermore, there are many gaps in the surviving records of individual assessments. There is one assessment—that of 1334—which is of very great interest because "the sums agreed upon in 1334 became the basis of a standardized fifteenth and tenth that lived until 1623."[39] This means that although detailed accounts for 1334 are not complete, we can interpolate backwards and so achieve a reasonably complete cover for that year.[40] This is a convenient date, coming as it does before the full impact of the recession of the late Middle Ages was felt. It would be an opportune moment from which to look backward towards the Domesday Inquest of 1086, and forward towards later assessments with their reductions against the figures of 1334. If we could use the figures in this way, they would open up the possibility of discerning changing patterns of regional prosperity. But the soundness of comparing the figures of 1334 with those of 1086 on the one hand, and with those of, say, 1445 or 1524–5 on the other hand, has yet to be evaluated.

The taxation assessments stand out as a body of evidence that, with all its drawbacks, may be made to provide us with some general framework in which to consider the agriculture and the population of the different regions of medieval England. Into this framework we might place the facts from surveys, from account rolls, from cartularies and, in short, from all that rich mass of evidence, lay and ecclesiastical, local and national, that dates from the later Middle Ages. Think, for example, of the light thrown by the cartulary and survey of Bilsington Priory upon the economy of both the Weald and Romney Marsh[41]; or of the way in which the Ramsey Cartulary illumines life and landscape in the Fenland and on the wooded claylands nearby[42]; or again of the hints the Abingdon Chronicle gives us of dairying in the Vale of White Horse.[43] These are but a few examples that come conveniently to mind. From such material we might begin to perceive the origins of those contrasted local economies that confront us so strikingly in the Tudor Age.

After 1500, the sources of information, already rich, became even richer both in quantity and in variety. The Tudors, in the words of Charles Whibley, "recognized that the most brilliant discovery of a brilliant age was the discovery of their country."[44] Surveyors and map-makers, antiquarians and natural historians, all combined to launch a rich tradition of topographical writing upon its course. This material contains a great deal of information about economic resources and about the varying face of the countryside. Much of it is too vague or too inaccurate for our purpose, but by the end of the eighteenth century it is clear that topographical description was coming to rest upon a relatively detailed knowledge of differences in soil and economy. The work of William Marshall and of the Reporters to the Board of Agriculture provide at about 1800 a broad basis upon which to generalize

about the regional economies of the kingdom.[45] Although this material is easily accessible and has been much used, it has not been fully exploited. Nor have the possibilities of the large-scale pre-Ordnance Survey county maps been completely explored and evaluated[46]; but some idea of these possibilities may be seen from the use made of the maps in a number of the reports of the Land Utilization Survey.[47]

The printed word of the time is not our only source. The assessments continued into the modern period—that of 1524–5 is particularly important—and they can be supplemented by the Hearth Tax Returns[48] and by the Muster Rolls.[49] Occasionally, they are particularly illuminating; the 1608 Return of the able-bodied men of Gloucestershire, for example, gives occupations as well as names, and so enables us to sketch the economic geography of the county in the early seventeenth century.[50] Then there is a vast array of rentals, terriers, surveys and inventories,[51] and of commercial and industrial information.[52] There is also the considerable body of material dealing with the changing geography of our towns, and in this connection we must note, for example, the series of town plans that accompany the county maps of John Speed's 'Theatre of the Empire of Great Britaine' (1611). As the seventeenth century moved towards the twentieth, the mass of material in general broadened out in every decade. Amongst the variety of sources, printed and unprinted, we may single out three groups that await a great concerted attack. They are, of course, not the only groups, but a thorough quarrying among these three alone would place our studies of the changing landscape upon quite a new footing.

The first group comprises the varied material dealing with field systems and with enclosure. H. L. Gray's pioneer study of 1915 yielded generalizations,[53] but forty years have brought an increasing awareness of how little we know and of what questions to ask. Much remains to be done before we can have a clear picture of field arrangements in, say, East Anglia or the Chilterns. One result of further investigation may be that our ideas will become less orderly. It would appear, for example, that the infield-outfield system, in one form or another, was very widespread, and that it was, certainly in part, a reflection of geographical circumstances. We may perhaps regard it as a device for utilizing poor soils—on the Wolds of Yorkshire and Lincolnshire, and on the heaths of Nottinghamshire and Staffordshire, of Norfolk and Kent, and in other places. Maybe when we know more we shall discern its presence even more frequently both in the two- and three-field area and in the south-east.

Our evidence must come from medieval and modern sources alike, and among the latter we must especially note the cartographic material that becomes available. It is interesting to see the association of agrarian change with the development of the "art of surveying of land," from the sixteenth century onwards, as witnessed in the Elizabethan and Jacobean surveys. Some of these were "elaborate topographical descriptions, furlong by furlong, and strip by strip, of complete villages, extending sometimes in length to a hundred pages of manuscript."[54] Others resulted in maps such as those beautiful works of art by John Blagrave and Ralph Agas towards the end of the sixteenth century.[55] These were the precursors of the eighteenth century strip maps and of the maps that accompanied the enclosure awards. Very few studies of such maps have appeared,[56] although today the work would be greatly facilitated by the collections of the various County Record Offices.[57] Our cartographic riches are probably as great as those of Germany or France, but we have nothing to compare with the work of Meitzen or of Marc Bloch.

The physical operation of enclosure must have been a most complicated one.

To survey up to three thousand or so interlocking pieces; to value and then to redistribute them; to set out roads; to reorganize the drainage of the fields; to settle conflicting claims; and finally to confirm an award—all involved long effort that sometimes lasted five years or more.[58] What in fact the enclosure commissioners did for a village was to lay out its territory afresh and so create anew much of the landscape we look upon today. It was an important formative process that needs much closer study if we are to understand our present field patterns aright. And associated with such study there should be a survey of existing ridge and furrow. Whatever be the bearing of ridge and furrow upon the history of our countryside, the phenomenon constitutes an important feature of micro-relief. Yet for only one county has a comprehensive survey of ridge and furrow been made.[59]

When some of the obscurities of field systems and enclosure have been made clear, one result will be to shed light upon forms of settlement. To pursue the study of settlement in isolation, and apart from an enquiry into field-systems, is to set at naught the realities of rural life in all ages. Furthermore, in our studies of settlement we must not forget the need for sustained enquiry into the 1300 or so deserted villages in the country.[60]

A second group of sources that cry aloud for attention is the body of Tithe Surveys made on a parish basis in the years around 1840. One's mind naturally turns to that paper on the south-west of the London Basin by E. C. Willatts in 1933.[61] What he did, in his own words, was "to illustrate the possibilities" of mapping the Returns. His maps of ten representative parishes, together with the sample parish maps that appeared in the Land Utilization Survey Report for *Middlesex and the London Region* (1937), constitute a notable contribution.[62] Since then, the Tithe Returns have been plotted over at least three fairly extensive areas—south-east Sussex by H. C. K. Henderson and H. B. Smith (1936, 1942),[63] north-west Norfolk by J. E. G. Mosby (1938),[64] and the Chilterns by F. D. Hartley (1953).[65] They have also been plotted for more limited areas, and for numerous sample parishes, in various reports of the Land Utilization Survey.[66] Well would it be if such work could be extended to give us as complete a map of England around about 1840 as is possible.[67] It would be an enormous task and an achievement of the first importance. From about the same date come the county Prize Reports in the *Journal of the Royal Agricultural Society*[68]; the combination of these reports and a series of maps based upon the Tithe Surveys would give us, certainly not an ideal but, at any rate, a tolerable picture of the English countryside at mid-century. The interest of such work would lie not merely in the delineation of a cross-section but in the provision of a body of data that could be compared for some localities[69] with that of the Ordnance Survey Area Books of about 1870 (another relatively unexploited source), and for all localities with the Land Utilization Survey of the 1930's itself. H. C. K. Henderson's study of the Adur Basin in Sussex, for example, has shown us the value of a comparison of these three sets of data.[70] But before 1870 many other sources had begun to appear. The official agricultural parish statistics of crops and livestock were first compiled in 1866[71]; and an increasingly wide variety of other sources was becoming available, though none that match the Land Utilization Survey itself.

The third body of material is that of the Census Returns from 1801 onwards. The distribution of population is one of the fundamental facts in the geography of any area, and yet there are no maps that show this distribution at successive decades in England during the nineteenth century, that is maps based upon the smallest available unit area. The decennial maps of the Liverpool and District Regional Survey Association were published as long ago as 1923.[72] Since then,

other maps for this or that area or period have been published [73] and, doubtless, more lie buried in the deep silence of unpublished theses; but there has been no comprehensive series that is national in scope. It is true that there are difficulties, and that the complications caused by changing parish boundaries must be examined to be believed, but the challenge is one that could be met. And from such maps, there might be constructed a second series showing intercensal changes. We need to know the varying rates of change through different periods and over different parts of the country. Some local studies have already shown us how relevant this information can be to an understanding of the growth of a region. There are, for example, B. C. Wallis's study of part of the Midlands,[74] A. E. Smailes's study of Northumberland and Durham,[75] and A. C. O'Dell's study of the Croydon area.[76] Such work whets our appetite for a view of population changes over England as a whole.

Then again, for the period from 1841 onwards, a third group of maps is possible —those showing movement of population. Arthur Redford's study demonstrated, in 1926, the possibilities of the material.[77] Not until the relevant details of the Census Returns have been mapped can an authentic picture of the changing face of nineteenth century Britain be given. Since 1926, there have been several studies, but the material as a whole still awaits the great attack.[78] There is also a fourth set of maps that might be compiled from the Census Returns—those showing occupations. I mention these with some trepidation because the occupational returns form is, in the words of the 'General Report' of 1881, "perhaps the least satisfactory part of the Census." How unsatisfactory they are, H. R. Wilkinson has shown us, and I can only quote his view that "in the absence of other adequate data this evidence deserves more careful geographical treatment than it has perhaps hitherto received."[79]

Such is a brief review, in rough chronological order, of some of the main sources that await their harvesting. But there is yet one other source upon which the interpretation of most other sources rests. I mean that "fullest and most certain of documents—the ground itself."[80] There is need not only for stout boots but for a convenient soil map on a moderately large scale. It is true that the fields are there to be inspected at any time, but this fact does not do away with the desirability for an ordered map. One showing merely soil texture would be invaluable for interpreting past distributions through a period when so much of living was bound up with agriculture. As long ago as 1851 Joshua Trimmer stressed the need for a soil survey as opposed to a geological survey[81]; and for England as a whole, we are still without this aid to our studies. The maps of the new Soil Survey, when completed, will at last fill this need.

Conclusion.—Such are a few reflections upon the plan of the volume of 1936, and a few comments upon the main categories of sources that either were available or might have been available. As far as the plan is concerned, one can but conclude that in the writing of historical geography there is no such thing as success, only degrees of unsuccess. As far as the sources are concerned, one can but say "So little done, so much to do." There is, however, one aspect not yet discussed. Writing about the country as a whole, or evaluating the several categories of material one by one, are not the only tasks that face an historical geographer of England. Think of the parts of England—of the Lincolnshire Wolds, the Lancashire Fylde, the Lower Severn Valley, the Yorkshire Moors, the Cotswolds, and of all those other districts with marked individualities. Here is plenty of scope for a series of local studies on an historical basis; call them regional studies if you will. Our hope

must be that a hundred years hence the materials for an historical geography of England will not be as we know them now. The sources will have been fully explored and evaluated. Numerous experiments will have prepared the way for a balanced presentation. A variety of regional monographs will be at hand to substantiate or modify this or that generalization. And by that time, we and our landscape will have become one more chapter in some other 'Historical geography of England.'

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IKTIN

SIR GAVIN DE BEER, F.R.S.

ROUND THE COAST of Great Britain there are many places where the map indicates a submerged forest, but the one with which I am now concerned is in Mount's Bay opposite Penzance in Cornwall (see Fig. 1). Two hundred years ago it was described by William Borlase in the following words[1]:—

"On the strand of Mount's Bay, midway betwixt the piers of St. Michael's

Fig. 1. Position of Iktin in Mount's Bay

Mount and Penzance, on the 10th of January, 1757, the remains of the wood which, according to tradition, covered anciently a large tract of ground on the edge of Mount's Bay, appeared. The sands had been drawn off from the shore by a violent sea, and had left several places, twenty yards long and ten wide, washed bare, strewed with stones like a broken causeway, and wrought into hollows somewhat below the rest of the sand: this gave me an opportunity of examining the following

[1] Borlase, William, 'Natural History of Cornwall,' Oxford, 1758, p. 221.

parts of the ancient trees: In the first pool, part of the trunk appeared, and the whole course of the roots, eighteen feet long and twelve wide, was displayed in a horizontal position; upon spading round, we found the sand to be a thin layer only of ten inches deep, and then the natural earth appeared, in which the roots remained so firmly fixed, that, with a pick and crow of iron, we could not get off one piece, but were content to saw off what we could come at . . . the roots were pierced plentifully by the *teredo* or augur worm. . . . The place where I found these trees was three hundred yards below full-sea-mark; the water is twelve feet deep upon them when the tide is in."

Similar concurrences of low tides and northerly gales have occurred more recently, and Borlase's description also applies to them. The only addition which need be made to his account is that the pieces of timber are embedded in a layer of "decayed plants interspersed with the bark, leaves and twigs of trees, which are sufficiently perfect to show that they almost all belong to the hazel," as Henry Boase wrote.[1] Hazel-nuts are abundant in this deposit from which it is concluded that the forest was overwhelmed by the sea in autumn or winter. From the observations made by Henry Boase and by Joseph Carne,[2] it is known that the vegetable stratum and the trees extended westward as far as Newlyn and eastward as far as Marazion Marsh, or practically over the whole width of Mount's Bay. How far they extended seaward is of course unknown, but it cannot be very far as the five fathom contour passes only 600 yards south of Penzance. It can only have been a small forest.

When was the forest submerged? It might be thought that this was immaterial, and that as the forest has gone for good there is no point in worrying about it. This would be a great mistake, for I hope to show that the date at which the forest in Mount's Bay was submerged is of great importance for the history of England.

About the middle of the first century B.C. Diodorus of Agyrion in Sicily wrote a book[3] in which he gave the first detailed description of Britain. "The inhabitants of that part of Britain which is called Belerion," [*i.e.* Land's End] he wrote, "are very friendly to strangers and their relations with foreign traders have civilized them more than others. They produce tin which they extract from the rocky ground into which they drive galleries. They melt the tin into ingots which they load onto carts and convey it to an island lying off Britain, called Iktin. When the tide is out the intervening space is dry, and they transport the tin over it to this island in their wheeled carts in large quantities. But there is a peculiar feature about these islands lying between Britain and Europe, for at high tide the passage to them is covered with water, although at low tide they are like peninsulas. It is here that the traders buy the tin from the natives and ship it over to Gaul where they load it on horses and bring it to Marseilles after a journey of thirty days overland."

To appreciate the full significance of this statement it must be remembered that in those ancient times tin had a strategic significance similar to oil or uranium today, and for the same reason. Weapons were made of bronze, a hard metal that does not rust, but to make bronze copper has to be alloyed with 10 to 15 per cent. of tin. The ancient civilizations of the Mediterranean could rely on supplies of copper in Cyprus, to which it gave its name, for copper was called kupros and Cyprus means the copper island. Copper was also obtainable in Italy. But tin was

[1] Boase, Henry S., "On the sandbanks of the northern shores of Mount's Bay," *Trans. R. geol. Soc. Cornwall*, 3 (1827), p. 166.

[2] Carne, Joseph, "Notice on the remains of submarine forest in the north-eastern part of Mount's Bay," *Trans. R. geol. Soc. Cornwall*, 6 (1846), p. 230.

[3] Diodorus Siculus, 'The History,' V, 22, 38.

harder to come by, and the sources available to the Mediterranean peoples were Spain, Brittany and Cornwall.

The name Iktin means tin port, just as Cyprus means copper island. Diodorus referred to Iktin in the accusative case, from which some commentators have deduced that the nominative case was Iktis, but there is no evidence for this and I shall continue to refer to it as Iktin. The village of Penestin on the headland south of the estuary of the Vilaine in Brittany means the tin cape. If Cornish tin played so important a part in the economy of the ancient world, it would be expected that Diodorus's account of it would be confirmed from other sources, and so it is. In about 323 B.C. a Greek sailor from Marseilles, Pytheas, set out by sea on an expedition to visit the sources of tin and of amber, during the course of which he visited Belerion or Land's End.[1] Another ancient author, Strabo[2] of Amasya in Pontus, writing at about the beginning of our era, said that tin was brought from Britain to Marseilles. As for the name Iktin, it is confirmed by two references. One dating from 270 B.C. in the writings of Timaeus of Taormina quoted by Pliny the Elder,[3] said that: "The island of Mictim in which tin is produced is distant inwards from Britain six days' voyage, and that the Britons sailed to it in coracles made of wicker-work covered with hide." How this geography is to be interpreted is not clear, although it has been suggested that the island has been confused with Thule (Iceland) mentioned by Pliny in the previous sentence. At any rate the word Iktin, even if garbled, can be recognized in "*insulam Mictim*" where the initial *M* has been repeated from the final *m* of the preceding *insulam*.[4] Iktin can also be recognized in the reference found in the Irish Glossary, or Cormac, and other Irish documents which speak of the English Channel as the Muir-n-Icht, or Sea of Ikt. There can therefore be no doubt that tin was exported from Cornwall to Gaul at least from the fourth century B.C. onwards until the Roman conquest, and that the place where the shipments were made and the natives came into contact with foreign traders was close to the tin deposits near Land's End, and that it was known as Iktin.

There is only one place that fits this description of Britain's earliest known port of export, and that is St. Michael's Mount, in Mount's Bay. On the mainland at Marazion immediately opposite the Mount (see Fig. 1), R. Edmonds[5] found the remains of a smelting pit and portions of a bronze cauldron and surrounded by ashes, charcoal and slag and the vitrified refuse of smelted ores. But if the forest of Mount's Bay was not submerged before the period of which Diodorus was writing, St. Michael's Mount would have been dry land and could not have been the Iktin to which the foreign ships came for their tin; and this possibility must be taken all the more seriously because of the old Cornish name for St. Michael's Mount, which means "the grey rock in the forest." The chronicler Florence of Worcester [6] wrote that St. Michael's Mount was originally five or six miles from the sea, enclosed in a dense forest, and that on the third [day] of the nones of November [A.D. 1099] the sea overflowed the shore, destroying towns and drowning many persons and innumerable oxen and sheep. Similarly the Saxon Chronicle[7] recorded under the date 11 November 1099, "The sea-flood sprung up to

[1] In Festus Avienus, 'Ora maritima.'

[2] Strabo, 'Geography,' III, 2, 9.

[3] Pliny, 'Natural History,' IV, 104.

[4] There is also the inscribed stone (c. A.D. 575) at Bleu Bridge 2½ miles from St. Michael's Mount which runs *Quentauci icdinui filius*.

[5] Edmonds, Richard, 'The Land's End district,' London, 1862, p. 9.

[6] Florence of Worcester, 'Chronicle,' translated by Thomas Forester, London, 1854, p. 206.

[7] 'Anglo-Saxon Chronicle,' translated by the Rev. James Ingram, London, 1923, p. 180.

such a height, and did so much harm, as no man remembered that it ever did before."

Even more recently, Clement Reid [1] has expressed the opinion that St. Michael's Mount was surrounded by a swampy wood well into historical times. If that was the date when the forest was submerged, then it will be necessary to look somewhere else for Iktin, and that is why the date of its submergence is important.

There are three methods by means of which it is possible to measure the age of a submerged forest. The first is by estimating the amount of the isotope carbon-14 remaining in the timber; for from the moment when the trees were killed by the seawater and sand overwhelming them they ceased to maintain and replenish the amount of this isotope in their tissues, and as it disintegrates at a known rate the time since they ceased to live can be calculated. Through the kindness of the late Mr. Thomas Williams, curator of the Royal Geological Society of Cornwall's Museum in Penzance, I was provided with several pieces of oak, taken [2] from the submerged forest about 100 yards below low-tide mark opposite Lariggan in 1883, and one piece obtained in 1953 by Miss A. Williams opposite Long Rock. A carbon-14 estimation on one piece of oak was carried out in Dr. Plenderleath's laboratory in the British Museum by Mr. Harold Barker, to both of whom I am deeply obliged. On the basis of a half-life of the isotope of 5568 years plus or minus 30 years, and allowing for possible fractionation of the isotope and fluctuation in the level of natural carbon-14 activity as well as in radio-activity measurements, the age of the timber worked out at 3656 years plus or minus 150 years. This gives a date of about 1700 B.C. for the submergence of the forest.

The second method is that of pollen analysis, for with the changes of climate and consequently of prevalent vegetation following the Ice Age, the percentages of the pollens of the different species of plants changed, in accordance with an order of succession which is now well known for England. Mr. Thomas Williams again very kindly handed to me a portion of the vegetable layer or peat bed in which the trees are embedded, which he obtained in 1956 from a point 15 yards from the sea wall, between Lariggan and the Wherry, after a heavy storm and a spring tide. This sample has been analysed by Mr. J. W. Franks of the University of Manchester, to whom I am most grateful. Of 500 pollen-grains from trees in the sample their relative frequency was as follows:—alder 362, oak 56, hazel 41, birch 36, beech 2, ash 1, maple 1 and pine 1. This assemblage is characteristic of the earlier part of the so-called Atlantic Age which extended from about 3000 B.C. to 1000 B.C., a time bracket which agrees well with the date of 1700 B.C. obtained from carbon-14 estimation of the age of the trees, and which allows Iktin to have been surrounded at high tide by all the water that the traders could possibly have required when they came there in their ships for tin in 400 B.C.

Before 1700 B.C. can be accepted as the date of submergence of the forest, there is a danger, as Professor H. Godwin, F.R.S., has pointed out. How can we be sure that the samples of the trees and of peat which we have studied are those that correspond to the last years of the forest, just before it was submerged? It is possible to imagine that they represent samples of a period some time before the submergence, and that the later and overlying layers of timber and peat were washed away by the sea. The only way to solve this problem is to find an exposure of a section on dry land where the forest has not been exposed to the sea, and where the whole extent of the forest bed and peat bed are revealed in their natural relation to

[1] Reid, Clement, 'The geology of the Land's End district,' London, 1907.

[2] Colenso, William, "Address of the President," *Trans. R. geol. Soc. Cornwall*, 13 (1910), p. 313. I wish also to thank Mr. Duncan McKie for his help in finding them.

underlying and overlying deposits. By great good fortune, such a section relating to the Mount's Bay Forest was found by Joseph Carne[1] at Marazion Marsh in a shaft sunk at a mine called Wheal Darlington to search for tin. In this section the uppermost 8 feet consist of slime and gravel brought down by the Marazion River. Below this was a layer of peat 4 feet thick representing the decay of recent vegetation. Below this again was a layer of sand 12 feet thick, representing the material brought in by the sea when the forest was submerged. Again below this was a layer of oak and hazel trees lying on a bed of peat. These are the remains of the forest, and the layer in which they lie is practically at the same level as that beneath the sea in Mount's Bay.

Samples of the materials found in these layers have fortunately been preserved, and they have also been analysed for pollen by Dr. Franks. They contain the same decreasing frequency series of alder, oak, hazel, birch, ash, and pine as in the peat-bed beneath the sea, and in addition they show a higher proportion of willows, sedges, and grasses.

Another site on dry land from which samples of peat have been preserved from a bed continuous with that beneath the sea is on the inland side of Western Green between Penzance and Newlyn, 3 feet beneath the surface, where Henry Boase[2] dug some trenches. The pollen-grains from this site have also been analysed and present a similar picture to that obtained from Marazion Marsh, and lead to the conclusion that they date from a period when alder was dominant and before human activities had created an open landscape, about 2000 B.C. at latest. The result of these studies therefore justifies the conclusion that the tree trunks and peat from the bed beneath the sea in Mount's Bay represent the age of the forest at the time when it was submerged, about 2000 B.C.

The third method of arriving at the date of submergence of the forest is by means of a study of the changes of level of land and of the sea at various places along the coast; but this is a problem of correlation of great difficulty, on which information is still scanty and uncertain. A subsidence of the land of 12 feet would have been sufficient to submerge the forest, and even less would have sufficed if the level of the forest was already low and protected from the sea by a low barrier of sand which a heavy storm could have broken through. The subsidence could have been quite slow and gradual, but evidence for this is hard to produce for, as Darwin remarked[3] under similar circumstances:—"it must be borne in mind how difficult it must ever be to detect a movement, the tendency of which is to hide under water the part affected." One of the results of recent research in Antarctica has been to show that there is much more ice in the world than had previously been imagined, and it is believed that its melting raises the level of the sea by 6 inches a century. If this rate was constant during the last four thousand years, it would amount to a relative subsidence of the land of 20 feet.

There is another field of research which bears on the present subject. Study of Neolithic stone axes can in some cases reveal the source from which the stone was obtained, just as it can be shown that the "blue stones" of Stonehenge came from the Prescelly mountains in Pembrokeshire. Dr. F. S. Wallis[4] has found that an axe discovered at Salisbury is composed of plagioclase felspar, ophitic augite and ilmenite with pleochroic hornblende, and that the Gear Rock, 500 yards south of

[1] Carne, Joseph, *op. cit.*, p. 233.
[2] Boase, Henry S., *op. cit.*, p. 172.
[3] Darwin, Charles, 'The voyage of the Beagle' (Everyman ed., 1955), p. 457.
[4] Stone, J. F. S., and F. S. Wallis, "Third report of the Sub-committee of the South-Western Group of Museums and Art Galleries on the petrological identification of stone axes," *Proc. prehist. Soc.* (1951).

Penzance on the 5-fathom mark, has a similar composition. In work of this kind it is always difficult to exclude the possibility that there may be similar rocks elsewhere; but if it could be established that the Gear Rock was a source of supply for axes in Neolithic times, it would provide additional proof that the Gear Rock, and the forest in the midst of which it lies, must then have been dry land.

It is impossible to talk about Cornwall without touching on that curious, tenacious and cherished legend which will have it that the Phoenicians came to Cornwall and the Isles of Scilly and traded for tin. The most ingenious reasons are advanced in support of this legend. Phoenicians are equated with Jews, and the names of Marazion and Market Jew Street in Penzance are pointed to as "evidence." Tin-smelting pits are known as "Jews' Houses." Even the dark eyes, hair and complexion of many Cornish folk are appealed to as an indication of descent from Phoenicians. As Cecil Torr[1] pointed out, the stories of Phoenicians coming to Cornwall or the Isles of Scilly are based on a blunder, which was started by Camden.[2] The trouble begins with the identification of some tin-bearing islands, variously called Cassiterides (from *kassiteros*, Greek for tin) and Oestrymnides (from the Celtic tribe the Oestrymni or Osismi who gave their name to Ouessant in Brittany). Strabo[3] said that the Cassiterides were islands in the sea "opposite" the Spanish Peninsula towards the north and that the tin trade with these islands was formerly in the hands of the Phoenicians. Elsewhere Strabo[4] said that tin was found in Spain and in the Cassiterides, and he also added that tin was brought from Britain to Marseilles. Although Strabo[5] twice went out of his way to enumerate the Cassiterides separately from Britain, and Diodorus[6] specifically stated that tin was brought from Britain to the Greek colony of Marseilles, which would make any Phoenician or Carthaginian turn in his grave with horror for they hated the Greeks, uncritical commentators have lumped Strabo's different statements together, forgotten Diodorus's account, and jumped to the conclusion that the Cassiterides were the Isles of Scilly and that, therefore, the Phoenicians formerly came there and to Britain.

Ezekiel referred to the riches in tin of Tarshish, Tartessos on the Guadalquivir, and it is difficult to suppose that the Phoenicians or their descendants the Carthaginians, who had convenient access to vast deposits of tin in Spain and in Brittany, would want to make the dangerous voyage to the Isles of Scilly where there is practically none at all. Nor would the natives of Cornwall, possessing the splendid port of Iktin, have risked their precious tin by shipping it to the Isles of Scilly. Wonderful as were the sea voyages of the early Celts, they had a healthy dislike of bad weather off dangerous capes, and the proof of this in the case of Land's End is the well-authenticated route which they established from St. Ives Bay to Marazion and Iktin for the benefit of the Irish trade with Gaul.[7] An additional reason against the use of the Isles of Scilly as a trading station is that the number of dwellings on them appears to have been extremely small, while the number of tombs is astonishingly great. Not only must the population have been very sparse, but the islands seem to have been regarded as sacred places, Islands of the Departed, of sinister omen.[8]

The fallacy of trying to make the tin islands into the Isles of Scilly can be fully

[1] Torr, Cecil, 'Small talk at Wreyland,' Cambridge, 1925, p. 274.
[2] Camden, William, 'Britannia.'
[3] Strabo, 'Geography,' III, 5, 11.
[4] Strabo, 'Geography,' III, 2, 9.
[5] Strabo, 'Geography,' II, 5, 30; III, 2, 9.
[6] Diodorus Siculus, 'The History,' V, 22, 38.
[7] Thomas, Ivor, "Isthmus of Penwith," *Stud. Cornish Geogr.*, 1 (1948), p. 41.
[8] Hencken, H. O'N., 'The archaeology of Cornwall and Scilly,' London, 1932, pp. 29, 34.

appreciated now that the French scholar M. Roger Dion [1] has shown where they really were, by interpreting the descriptions given by the Roman author Festus Avienus in his poem 'Ora maritima,' which is based on accounts of sea voyages undertaken by the Carthaginian Himilco in the fifth century B.C., and the Marseilles Greek Pytheas in the fourth century. The tin islands, Avienus said, were in an arm of the sea, within sight of wide plains and rich mines of tin and lead, and they were opposite two islands, a further one, Ireland, and a nearer one, Britain.

Before the estuary of the Loire became silted up in late Roman times, the Bay of Biscay led into a wide gulf, now represented by the lower reaches of the river

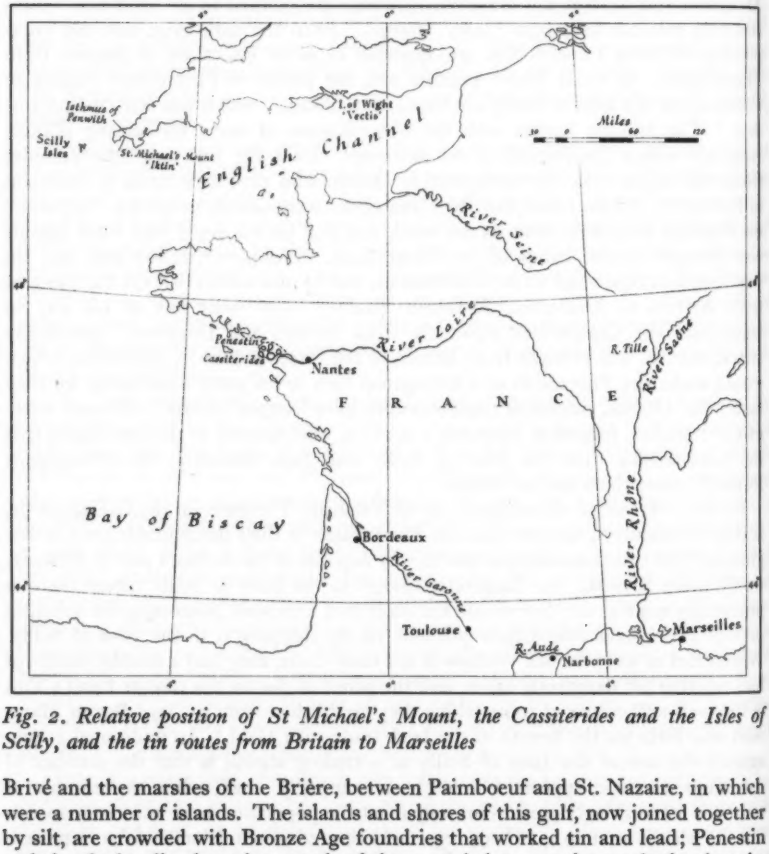


Fig. 2. Relative position of St Michael's Mount, the Cassiterides and the Isles of Scilly, and the tin routes from Britain to Marseilles

Brivé and the marshes of the Brière, between Paimboeuf and St. Nazaire, in which were a number of islands. The islands and shores of this gulf, now joined together by silt, are crowded with Bronze Age foundries that worked tin and lead; Penestin and the tin headland are just north of them; and there can be no doubt that the famous tin islands were there (see Fig. 2). The identification of these Breton islands with the Cassiterides finds confirmation in the writings of Strabo[2]: the Cassiterides are ten islands in the sea, north of the land of the Artabrians (north-west corner of Spain). One of the islands is deserted, the others are inhabited by people who wear black cloaks, long tunics, high belts, carry canes and walk about like

[1] Dion, Roger, 'Le problème des Cassitérides,' *Latomus*, II, 1952, p. 306.
[2] Strabo, 'Geography,' III, 5, 11.

goddesses of vengeance in tragedies. They were nomads and lived on their herds and traded tin and lead from their mines and hides from the cattle with merchants who came by sea, formerly exclusively Carthaginians who kept the sea route secret. Eventually Publius Crassus went to these islands, and found that the mines were not deep, and the people peaceable. Traders then knew where to go, though the sea journey thither (through the straits of Gibraltar) was longer than that across the Channel from the continent to Britain. Not only can these islands with their former nomads and their herds of cattle never have been the Isles of Scilly, but they are practically pin-pointed in Brittany by the name of Publius Licinius Crassus, for that was precisely where he was fighting under Caesar [1] in the Gallic War in 56 B.C.

The traders who came to Iktin for tin, until Caesar stopped this traffic by conquering Gaul and smashing Marseilles, were agents of the Greek colony of Marseilles and were carried in Celtic ships which plied between Cornwall and Nantes at the mouth of the Loire as Strabo [2] said they did, and whence by Bordeaux, Toulouse, and Narbonne the tin reached the Mediterranean. It is remarkable that the patron saint of one of the churches nearest to Iktin, Gulval, was neither Cornish nor Irish, but came from Brittany [3]: Locoal = *Locus Gutuali* on an island in the inland sea of Etel near the islands which M. Dion has identified as the tin islands. Another trade route linking Britain with Marseilles was even further removed from any Phoenicians, for it ran up the rivers Rhône and Saône and down the Seine to the English Channel which, according to Strabo,[4] was crossed in one day to the Isle of Wight. From the fact that the name given to the Isle of Wight by Pliny and Suetonius was *Vectis*, attempts have been made to identify it with Iktin. But it is nowhere near any tin; if it was used as a trading centre the best explanation of its name is that put forward by M. Jérome Carcopino,[5] who showed how easily it could be derived from the Latin words for transport: *vehere*, *vector*, *vehiculum*. Pliny [6] mentions another island called *Vectis* between England and Ireland.

Marazion and "Jews' Houses" were no relics of Phoenicians; Marazion and Market Jew Street are corruptions from *marghasyow*, plural of *marghas*, Cornish meaning "markets," dating from the twelfth century A.D. and referring to the market at the end of the pilgrim's route to St. Michael's Mount, as Mr. Charles Thomas has kindly informed me. The dark complexion of the Cornish folk is due to their preserving genes from the original Neolithic pre-Celtic peoples of whom purer populations are to be found in the Basques and the Ligurians, as I [7] have shown elsewhere. We even have place and river names in Britain such as Albion, Albany, London, Kent, Douaernon (= Canterbury), Rutupiae (= Richborough), Thames and Tamar, which betray their Mediterranean origin from people who spoke a pre-Indoeuropean language but they were not Phoenicians.[8]

Finally, I cannot hope to avoid being asked whether my submerged forest in Mount's Bay throws any light on that other indestructible legend, the existence of Atlantis, and the answer is none at all. But I hope that it will be agreed that it was worth while to discover when the forest in Mount's Bay was submerged.

[1] Caesar, 'Gallic War,' III, 1, 2.
[2] Strabo, 'Geography,' IV, 5, 2.
[3] Doble, G. H., 'Saint Gudwal or Gurval,' Truro, 1933.
[4] Strabo, 'Geography,' IV, 1, 14.
[5] Carcopino, Jérome, 'Promenades historiques aux pays de la dame de Vix,' Paris, 1957, p. 40.
[6] Pliny, 'Natural History,' IV, 103.
[7] de Beer, Sir Gavin, "The inhabitants of Switzerland," *J.R. Soc. Arts*, **106** (1958), p. 413.
[8] Alessio, Giovanni, 'L'origine du nom de Londres,' Actes et Mémoires du Troisième Congrès International de Toponymie et d'Anthroponymie, Bruxelles, 1949: **2** (1951), p. 223 (Louvain).

CERRADO, CAATINGA AND PANTANAL: THE DISTRIBUTION AND ORIGIN OF THE SAVANNA VEGETATION OF BRAZIL

M. M. COLE

PERHAPS OF ALL TYPES of vegetation the savanna is the most difficult to define, the least understood and the one whose distribution and origin is the most subject to controversy; this paper attempts a contribution to the understanding of the problem.

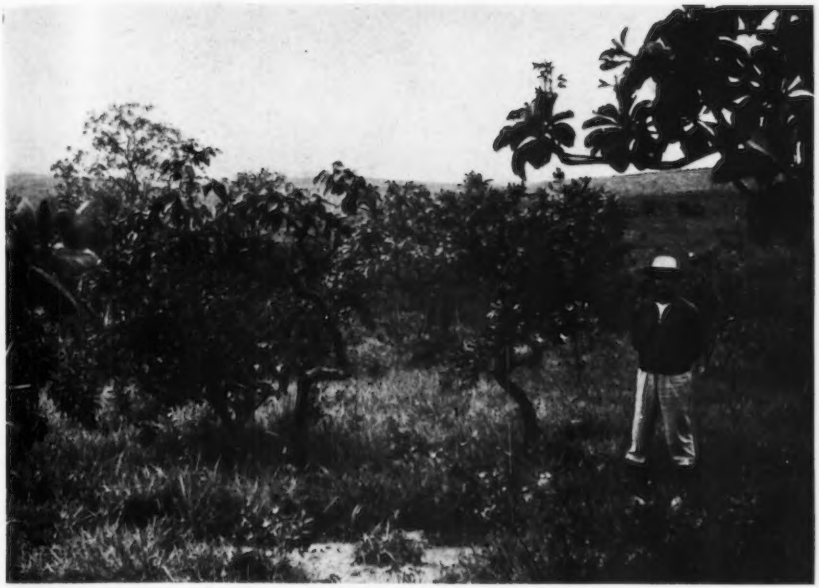
A definition of the savanna lands

The term savanna is an Amerindian word which first appeared in print in 1535, when Oviedo used it in a work on the Indies to describe "land which is without trees but with much grass either tall or short." Since then the term has come to embrace also the mixed tree and grass types of vegetation found in all tropical latitudes. In tropical America it is used for any grassland, with or without trees, natural or man-made, and in British Guiana it is even applied—in my opinion quite wrongly (see p. 177)—to areas of herbaceous swamp from which grasses as well as trees may be absent. Beard (1953)[1] has even defined the savanna as a "plant-formation of tropical America comprising a virtually continuous ecologically dominant stratum of more or less xeromorphic herbs, of which grasses and sedges are the principal components, with scattered shrubs, trees or palms sometimes present." In southern Africa the term is applied both to the tropical grasslands with or without trees of the eastern coastal belt, to the lowveld and bushveld, and to the thornveld of the eastern Kalahari and northern Zululand.

In this study of the savanna of Brazil I am including the types of vegetation known as cerradão, campo cerrado, campo sujo and campo limpo, the pantanal and the caatinga. The first two are classified as semi-deciduous tropical forest, the second two as tall grass savanna by Professor Linton in his world vegetation map in the Oxford Atlas, but there is a continuous sequence from the dense tangled scrub of the cerradão to the open grassland of the campo limpo with the same species present in all types. The pantanal is also a mixture of grassland and trees. The caatinga, classified by Professor Linton as tropical deciduous xerophytic woodland, is quite different. It includes the high thorn forest found in the area known as the Agreste and the low thorny and succulent scrub of the Sertão. With its paucity of grasses the caatinga, strictly speaking, is not a savanna type but in some ways it resembles the scrub of the South African lowveld and thornveld and it must be studied if the distribution and origin of the grassy savannas are to be fully understood.

The views of other writers on the distribution and origin of the savanna vegetation of Latin America

The distribution of the savanna vegetation has been variously explained by a number of writers who have held either climatic or pedological or biotic factors or a combination of these to be responsible. Most of the writers favouring climatic influences have emphasized the importance of rainfall periodicity and moisture deficiency. Grisebach (1872),[16] Schimper (1903),[36] Hayek (1926),[18] Bews (1929)[3] and Bouillienne[4] all attributed the grassy savannas directly to alternating wet and dry seasons. Warming (1892),[39] however, in his classic work on the vegetation around Lagoa Santa in Minas Gerais, associated the campos cerrados with a seasonal climate combined with special soil conditions which he believed caused a periodic deficiency of moisture. Myers (1936),[25] on the other hand, regarded alternating wet and dry seasons as of fundamental importance but recognized that the vegetation had subsequently been



1. *Typical campo cerrado covering the level plateau near Lagoa Santa, Minas Gerais. Top right,* Salvertia convallariodora, *Vochysiaceae; centre right, a* Kielmeyera sp., *Gutteriferae; centre left,* Qualea grandiflora, *Vochysiaceae*

2. Salvertia convallariodora, *Vochysiaceae; note leaf clusters and flower spikes with fruits split to leave only leathery outer cover*

3. Cerradão near periphery of the high chapada between Carmo de Paranáibo and Lagoa Formosa, Minas Gerais; altitude about 1000 metres (3000 feet)

4. Cerradão on periphery of the Chapada da Ponte Firme, north of Presidente Olegario, Minas Gerais. Tall tree is a sucupira, found both in cerradão and mata; in front a pau santo, typical of campo cerrado. Here the chapada is developed over Triassic sandstone thinning towards the valleys cut into the Silurian rocks below. Cerradão occurs where Triassic sandstone capping is thin and surface slightly inclined

5. Campo cerrado grading to campo sujo on high, windswept plateau between Carmo de Paranáibo and Lagoa Formosa, Minas Gerais. Altitude about 1000 metres (3000 feet)

6. Campo sujo on the Chapada de Guimarães, east of Cuiabá, Mato Grosso

7. Very open campo cerrado grading to campo sujo covering the level peneplaned or pediplaned surfac studded with inselberge near Feira de Santana, Bahia. Surface ascribed to the Velhas cycle by L. C. King. Willowy trees are mangaba

8. Savanna vegetation near Curvelo, Minas Gerais; poor campo cerrado in foreground changing abruptly to cerradão in background where change from level to gently sloping surface is matched by a change from grey to red sandy soils

9. Caatinga scrub near Arcoverde, Pernambuco, composed of numerous genera and different species, all characteristically thorny and/or succulent. Tall cactus in centre is the faxeiro

10. Caatinga scrub of the Sertão near Arcoverde, Pernambuco, dominated in the foreground by giant creeping cactus, the xique-xique. Note nature of surface in background: level peneplain or pediplain studded with inselberge

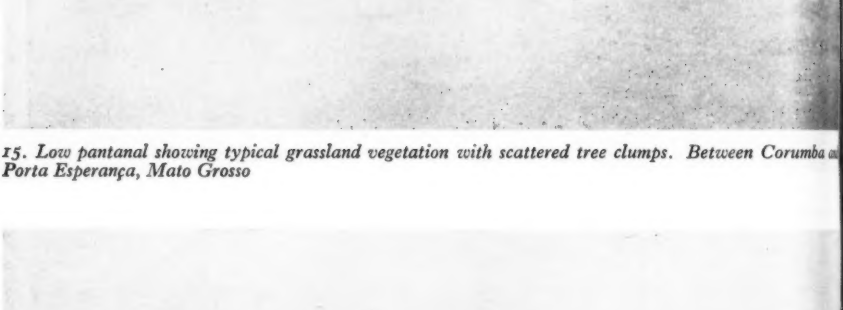
11. High caatinga forest near Garanhuns, Pernambuco. Trees are caatingueiras; tall cactus behind, the faxeiro

12. High caatinga forest in winter near Tucano, Bahia

13. Tall evergreen forest trees, Capparis *ico, Capparidaceae, following a dry water-course; note contrast with surrounding caatinga, bare of leaves in winter. Between Poçoes and Jequie, Bahia, September 1956*

14. Aerial view of the pantanal; note restriction of forest to higher, drier sites

15. Low pantanal showing typical grassland vegetation with scattered tree clumps. Between Corumba a Porta Esperança, Mato Grosso



16. High pantanal composed essentially of grassland with scattered tree clumps. Between Porta Esperan and Bodaquena, Mato Grosso

modified by fire. More recently Troll (1956) has reiterated the purely climatic relationship, basing his views on the similarity of life form in the vegetation formations of comparable climatic regions.

Among those writers who regard pedological factors to be of greatest importance, some have based their arguments on mineral deficiency in the soil, others on defective sub-soil drainage. Thus Jones (1930)[21] and Waibel (1948)[38] believed that certain geological formations developed poor soils capable of supporting only a savanna vegetation. Pulle (1906),[28] Ijzerman (1931),[20] Lanjouw (1936)[23] and Hardy (1945)[17] thought that profound leaching of the soil produced a poor, low forest which was readily fired and thereby converted into savanna. By contrast, more recent writers, notably Bennett and Allison (1928),[2] Charter (1941)[6] and Beard (1944, 1953)[1] have associated savannas with more or less flat areas with impeded soil drainage caused by the presence of an impermeable layer in the soil. Here it is interesting to note that Henkel (1930),[19] in his studies of the Rhodesian savanna, remarked on the inability of forest trees to become established in areas subject to periodic waterlogging. In contrast with those who regard the savanna vegetation as a product of the physical environment, some writers, notably Christoffel (1939),[7] Rawitscher (1948)[33] and Ferri (1955),[14] have concluded that it is fire-induced, having replaced forest which was burnt by man. In this they accord with the views of Phillips (1930)[27] in South and East Africa and Stebbing (1937)[37] in West Africa.

None of these views, taken either separately or in combination, however, satisfactorily explains the present distribution of the savanna vegetation of Brazil. None of these writers appears to have recognized the importance of the essentially dynamic nature of vegetation. In this paper, therefore, attention will be directed to this hitherto neglected feature and an attempt will be made to see the present distribution of the savannas not only in relation to the climatic, edaphic and biotic influences operative today, but also in relation to landscape evolution and climatic change.

Nature of the grassy savannas of Brazil

Included in this category are the campo cerrado, the cerradão, the campo sujo and the campo limpo. The campo cerrado, which means "close dense, open country," comprises a mixture of tall grasses and low contorted trees—4 to 8 metres (12 to 24 feet) high and characterized by thick corky barks. The vegetation is close and dense in the sense that the trees are closely spaced and their growth tangled, open in the sense that the canopy is not closed; light can penetrate to the ground which is covered with grasses through which movement is relatively easy (Plate 1). Most of the common trees have very large leaves which are borne in rosette-like clusters at the tips of the branches (Plate 2). The leaves are either hard and leathery, *e.g.* the pau santo (*Kielmeyera* spp., Guttiferae), pau de arara (*Salvertia convallariodora*, Vochysiaceae) pau terra (*Qualea* sp., Vochysiaceae) and pequi (*Caryocar* sp., Caryocaraceae); or sand-papery, *e.g.* lixeira (*Curatella americana*, Dilleniaceae); or excessively hairy, *e.g.* peroba de campo (*Aspidosperma* sp., Apocynaceae) and murici (*Byrsonima* spp., Malpighiaceae). By contrast, the leguminous trees, of which two species both known as barbatimão (*Stryphnodendron barbatimam* and *Dimorphandra mollis*) are common in some areas, have delicate pinnate leaves, while the mangaba (*Hancornia speciosa*, Apocynaceae) found in the wetter areas has small tough leaves. All these trees retain their foliage during the dry season and they continue to transpire freely.[11, 14, 30, 33] The trees may lose their leaves for a very short period—perhaps only a few days—at the end of winter, but they do not shed them simultaneously and the vegetation cannot be regarded as deciduous. In this respect the campo cerrado differs from the caatinga and from the thorn savanna of Africa. Between the trees the most common grasses are the capim flecha (*Tristachya chrysothrix*), barba de bode or goat's beard (*Aristida pallens*), gordura or molasses grass (*Melinis minutiflora*) and various species of Aristida, Paspalum, Panicum and Andropogon.

In one direction the campo cerrado grades to the cerradão (Plate 3), a high dense growth composed of the same species but with trees attaining a height of 10 to

15 metres. A few trees characteristic of the mata (or forest) may also be present, notably the sucupira de mata (*Bowdichia* sp., Leguminosae), jatobá (*Hymenaea* sp., Leguminosae), angicó (*Piptadenia* sp., Leguminosae) and jacarandá (*Machaerium* sp., Leguminosae) (Plate 4).

In the other direction the campo cerrado grades into the campo sujo or "dirty grassland" (Plates 5 and 6), consisting of grassland with shrubs and scattered trees, mainly pau santo (*Kielmeyera* sp.) which seldom reach a height of more than 2 or 3 metres. As the trees and shrubs become fewer in number and species, and of lower stature, the campo sujo passes gradually into the campo limpo or "clean *i.e.* pure grassland," which in most cases is characterized by *Aristida* spp.

The distribution of the grassy savannas

The main belt of grassy savanna occurs over the high interior plateaus or chapadões of the Mato Grosso, Goiás and Minas Gerais. There all types are represented with, generally speaking, campo limpo occupying the centres of the plateaus and being succeeded in turn by campo sujo and campo cerrado towards their periphery. Grassy savannas, usually campos cerrados, however, occur again on the coastal taboleiros of Bahia, Sergipe, Alagoas and Pernambuco, as well as north of the Amazon in Amapa and the various Caribbean territories. Their distribution is thus discontinuous, with great stretches of forest clothing the intervening areas. Over the interior the savanna is unbroken over vast areas but in the eastern coastal belt it is broken up by numerous ribbons of forest extending inland from the mata zone of the littoral. In both areas, however, it covers level plateau surfaces which represent peneplains* or pediplains

* The term *peneplain* is used to describe a level featureless surface produced by prolonged erosion. It was first used by W. M. Davis to describe the surface features of the Connecticut valley as follows:—"the faulted ridges of the Connecticut must have been reduced to a low base-level plain . . . a nearly featureless plain, a 'peneplain,' as I would call it, at a low level." Later he refers to the "featureless surface or peneplain of its old age." ("Topographic development of the Triassic formation of the Connecticut valley," *Amer. J. Sci.*, Third Series, 37–8 (1880), pp. 423–34.) In this paper the term is used to describe the level plateaus of Brazil which have been produced by prolonged erosion, without invoking any of the particular erosive processes which may have been involved.

The term *pediplain* is used to describe a level featureless surface produced by the processes of pediplanation. The term was first used by J. H. Maxson and G. H. Anderson to describe "widely extending rock-cut and alluviated surfaces . . . formed by the coalescence of a number of pediments and occasional desert domes." ("The terminology of surface forms of the erosion cycle," *J. Geol.*, 43 (1935), pp. 88–96.) Later A. D. Howard introduced the term *pediplane* "as a general term for all degradational piedmont surfaces produced in arid climates which are either exposed or covered with a veneer of contemporary alluvium no thicker than that which can be moved during floods." He embodied under pediplanation all the processes by which pediplanes are formed. ("Pediment passes and the pediment problem," *J. Geomorph.*, 5 (1942), pp. 2–31 and 95–136.) Today the terms pediplains and pediplanes are regarded as synonymous, with the former enjoying the wider usage. L. C. King is the leading exponent of the pediplanation cycle which he regards as one "under which the dominant forces operating are, in order of their appearance, river incision, scarp retreat and pedimentation." "From the steep hillside sweeps outward a flatter pediment with a surface concave upwards. Normally veneered with detritus, both residual and transported, pediments are essentially rock-cut features. Pediments originate and grow by retreat of the hillslopes above them." "Throughout maturity opposing scarps meet from the opposite sides of hills, which are thereby rapidly lowered." In time only residual hills known as inselberge remain. Later "The inselberge disappear, relief decreases markedly and with coalescing of the ever-increasing pediments a bevelled landscape of low relief and multi-concave form, a pediplain, is produced." ('South African Scenery,' Edinburgh, 1951, 2nd edition.)

The use of the term pediplain implies that particular geomorphological processes have been in operation in fashioning the existing landscape. Where the expression "peneplain or pediplain" is used in this article it signifies an element of doubt in the mind of the author. She believes, however, that most of the features concerned have been fashioned by the processes of pediplanation.

For considerations of the peneplain concept, the pediment problem and the arid erosion cycle see William D. Thornbury, 'Principles of geomorphology,' New York, 1954.

either formed over more or less horizontally disposed Cretaceous to Tertiary sedimentary rocks or cut across folded pre-Cambrian to Palaeozoic sedimentaries and ancient crystalline rocks (Plate 7). It is not found over sloping terrain, being replaced by mata along the valleys cutting back into the plateaus and wherever the surface becomes dissected. Everywhere the change from savanna to forest is abrupt. There is rarely any transition zone in which savanna and forest species are intermixed and in many cases the boundary is actually linear.

Relationship between the distribution of the grassy savannas and the physical environment

The influence of climatic factors.—On the high plateaus of central Brazil the grassy savannas occupy country with a seasonal climatic regime. The summers are hot and rainy, the winters cool and dry. The climate is remarkably uniform over extensive areas. The winter drought is perhaps most marked on the highest and most central plateaus but everywhere the atmosphere remains moist and dew often forms at night. Frosts are practically unknown, but strong winds are a characteristic feature of the winter season and combined with low temperatures and drought may be unfavourable for tree growth. They are felt most sensibly on the highest and least broken plateaus where, significantly, the campo cerrado grades through campo sujo to campo limpo. Elsewhere, however, the presence of mata within the savanna zone casts some doubt on the influence of climatic factors over the distribution of the latter vegetation type. Here the patches of mata clothing the undulating volcanic country near Patos, which lies within and rises slightly above the main campo cerrado belt of Minas Gerais, and likewise the mata covering the hilly country between Goiânia and Anápolis within the savanna belt of Goiás[9] may be instanced. On the taboleiros along the east coast the grassy savannas occur in a zone where the temperatures are high throughout the year and the rainfall is certainly adequate and sufficiently well distributed to support forest. Here factors other than climatic ones must clearly be responsible for their occurrence.

The influence of pedological factors.—The association of grassy savannas with level peneplaned surfaces and of mata with sloping or dissected terrain suggests that their distribution may be influenced by soil and ground water conditions.

On the plateaus the soils, for the most part derived from sandstone, are generally sandy and infertile; varying in colour from grey to red, they lack humus and have been leached of their more readily soluble minerals. They vary in depth from a few inches to several feet. In some areas soils in the accepted sense are lacking and the surface is covered only by surficial accumulations of sand, gravel and pebbles and by deposits of ferruginous concretions. The last mentioned make up the lateritic iron pan known as the canga. In places this occurs at the surface, elsewhere it forms a hardpan below variable thicknesses of sand. The sandy soils have a poor moisture retaining capacity. Rainwater rapidly soaks through them but the hardpan arrests its further downward percolation and causes poor drainage conditions. Shallow lakes may even form over the surface after rain. Under such conditions only shallow-rooted plants able to withstand alternating waterlogging and drought, and deep-rooted species able to draw upon the ground water (which usually occurs at a depth of 10 to 20 metres below the surface) are able to survive. It is almost certainly the ability to draw upon the ground water which enables the cerrado trees to retain their leaves and transpire freely throughout the dry season.[33, 35] On the other hand inability to do so, combined with intolerance of alternating waterlogging and drought, precludes the trees of the mata from the level plateau.

The characteristic features of the plateau soils are due to the fact that they are old and exhausted. Because of the absence of slope the exhausted surface layers are not readily removed by the agents of normal healthy erosion, and soil renewal through replacement by material weathered from the parent rock proceeds extremely slowly if at all. Consequently with continued leaching the soils become progressively poorer and the hardpan more sharply defined and more fully developed. Wherever, however, there is some slope, as in a valley or over dissected terrain, there is a healthy balance

between soil removal and soil renewal, a higher level of fertility is maintained and the soils have a good moisture-retaining capacity and are well drained. Moreover, the ground water table occurs at shallower depth. Under such conditions forest trees are able to establish themselves. Thus the sudden change from savanna on the plateaus to mata in the valleys and over dissected country is readily explained by the character and mode of formation of the soils, and also by the ground water conditions.

The importance of the influence of soil and drainage conditions on the vegetation of the plateaus is further emphasized by the fact that slight declivities or baixadas, where the drainage is better and the soil less severely leached, usually carry cerradão, while areas of good soil and good drainage carry mata. Thus around Curvelo in Minas Gerais the abrupt change from campo cerrado to cerradão, where a change in the surface configuration from level to gently sloping is matched by a change from grey sandy to red sandy soils, is very impressive (Plate 8). Likewise the patches and ribbons of mata covering the undulating country developed over volcanic tuffs near Patos de Minas and over intrusive gabbros and diorites in the Mato Grosso de Goiás, west of Goiânia and Anápolis, provide a striking contrast to the adjacent cerrado covered chapadões. In each area they are associated with more fertile soils and better drainage conditions.

The role of fire.—Following the example of various writers on the African savanna, some people, notably Rawitscher and Ferri, have attributed to fire a major role in the formation of the campos cerrados. But while fire may have modified the vegetation in those parts of Africa which have been peopled for a very long period, it is unlikely to have been of major significance in the scantily peopled interior of Minas Gerais, Goiás and the Mato Grosso, where the core of the campo cerrado is found. Moreover, if an area of forest within a forest region is burnt down today, the forest is not replaced by campo cerrado. Where, however, forest is burnt down in the mata/campo cerrado boundary zone, there is a tendency for cerrado species to invade the formerly forested area. The fact that Rawitscher and Ferri have carried out most of their work in such a boundary area near Piraçununga no doubt accounts for the importance they attach to the influence of fire. It should be emphasized that the campo cerrado constitutes a homogeneous type of vegetation composed of distinct species with well defined characteristics; this clearly recognizable type of vegetation covers vast tracts of country; and both in its core area in central Brazil and in the outlying areas along the east coast and again north of the Amazon, its character and composition are, broadly speaking, the same. This uniformity between areas so widely separated from one another makes any contention that the campo cerrado is fire-induced extremely improbable. Among other things it is difficult to see how the seeds of the typical cerrado species could be carried thousands of miles across densely forested country to the numerous areas in which campos cerrados are found today.

The nature of the caatinga and its relationship to the physical environment

The caatinga is strikingly different from the grassy savannas. It consists essentially of thorny trees and shrubs which lose their leaves during the dry season,[12, 13, 14, 15] of spiny succulents and of low-growing herbs which come up after rain.[8] It occupies the hot, arid north-east of Brazil where its distribution is governed mainly by the duration and intensity of drought. Outlying patches, however, occur in the pantanal and caatinga species are prominent on the restingas—the old sand dunes and sand spits along the east coast.

Within the main caatinga zone differences of relief, rainfall, ground water conditions and soils are associated with differences in the nature and composition of the vegetation. Thus the extensive level peneplains which are cut across ancient crystalline rocks and are characterized by stony surfaces with little or no soil carry only the low scrub of the Sertão (Plates 9 and 10). This consists of thorny jurema trees (*Mimosa* spp., Leguminosae), the giant creeping cactus xique xique (*Pilocereus gounellei*), small jointed cacti called quipá (*Opuntia* spp.), and various thorny euphor-

bias, small cacti and bromelias. By contrast the undulating surface of the less arid Agreste appears originally to have carried high caatinga forest, although as a result of centuries of occupation and cultivation little—and that most probably secondary growth—remains today. The caatinga forest (Plate 11) is dominated by the caatingueira tree (*Caesalpinia pyramidalis*, Leguminosae) associated with giant cacti, especially the mandacaru (*Cereus jamacaru*) and faxeiro (*Cereus squamosus*) and numerous low growing opuntias and euphorbias. All the trees shed their leaves during the dry season (Plate 12) and even during the rainy period severely restrict their transpiration during the middle of the day.[12, 13, 14, 15] On the slopes of the serras, however, the higher rainfall and more humid atmosphere, combined with better soils and more favourable ground water conditions, supports a more luxuriant growth in which evergreen braúna (*Quebrachia brasiliensis* Anacardiaceae), joazeiro (*Zizyphus joazeiro*, Rhamnaceae) and imbuzeiro (*Spondias tuberosa*, Anacardiaceae) trees are present. The last-mentioned, however, possesses underground water storage organs, which enable it to withstand drought. Along the dry watercourses, in both the Sertão and the Agreste galleries of caraibeira (*Tabebuia caraiba*, Bignoniaceae), oiticica (*Licania rigida*, Rosaceae) and icó (*Capparis* spp., Capparidaceae) trees which likewise retain their leaves throughout the year, reflect the presence of ground water within reach of their roots (Plate 13).

The pantanal

Fascinating in its complexity is the vegetation of the pantanal (Plate 14). The extensive flat lands following the Paraguay River and its tributaries are flooded for several months each year between December and May. Only isolated hills and low ridges a few metres above the level of the water remain dry. In this environment, subject to alternations of long periods of drought and of inundation, differences of soil and degree of inundation are responsible for a variety of vegetation types. Characteristic is grassland composed of Angola grass (*Panicum spectabile*), capim mimosa verdadeiro (*Paratheria prostrata*), capim mimosa vermelho (*Setaria geniculata*), capim de bezerro (*Paspalum repens*) and capim araguaia (*Paspalum fasciculatum*). But dotted through the grasslands are clumps of trees (Plate 15), usually the cerrado species ipé roxa, ipé amarelo (both *Tecomia* spp.) and the lixeiro, the latter generally growing near termite nests around which sediments accumulate, allowing small portions of the soil to be protected against the flood waters. Away from the rivers, in the areas above the level of the normal floods, the clumps of trees become more numerous and the transition is made from the low to the high pantanal (Plate 16). The latter grades to campo cerrado where complete freedom from flood is associated with an apparently random distribution of trees. On the higher levees adjacent to the main river there are patches of mata and on dry stony ground caatinga forest is characteristic. The pantanal is thus a complex in which the several types of savanna and the mata are all represented.

The origin of the savanna vegetation

In seeking an understanding both of the present distribution of the savannas and of the manner in which this distribution has come about, attention must be directed to the role of dynamic change in the vegetation and to its relationship with the geomorphological evolution of the landscape.

Historical plant geography and the role of dynamic change.—In studying the historical plant geography of tropical Brazil, the present distributional relationships between the grassy savannas, the caatinga and the mata are of fundamental importance. Here the discontinuous nature of the distribution of both the grassy savannas and the caatinga is of outstanding significance, the former with its main centre over the interior plateaus and outlying areas in the eastern coastal belt, the latter with its main centre in the north-east and outlying areas in the pantanal and along the east coast. By contrast, except where cleared by man, the mata has a continuous distribution,

occurring along the coasts and extending in finger-like projections up the valleys towards the interior.

Equally important are the distributional relationships between the grassy savannas and the mata and between the caatinga scrub and caatinga forest. Here the coincidence of the grassy savannas with high-level plateaus and the abrupt change to mata over the dissected country at their periphery, and along the valleys cutting back into them, is notable. So likewise is the occurrence of caatinga scrub over the low-lying peneplains, whereas caatinga forest occurs on the slopes of the serras rising above them and again over the dissected country at their periphery.

The distributional relationship between the grassy savannas and the caatinga is likewise significant. It is most clearly seen in Bahia where the two types of vegetation interdigitate in a number of localities. In the south, near Vitória da Conquista, campo cerrado covers the higher plateaus whereas caatinga occupies the lower ground. Farther north, near Tucano, "islands" of campo cerrado occur over the small taboleiros of Cretaceous to Tertiary rocks which rise above the extensive caatinga-covered pediplains cut across ancient crystalline rocks below. Both types of vegetation cover level terrain but the campo cerrado occupies the higher surfaces. Throughout the state of Bahia either caatinga forest or a dry scrubby type of mata cover the escarpments separating the peneplaned plateaus and likewise the slopes of the serras rising above them, while ribbons of tall, evergreen trees follow the watercourses and provide a connecting link with the mata along the coast.

The distributional relationships between the grassy savanna, caatinga and mata suggest that all three vegetation formations are in a state of flux. Near the limits of their distribution their composition is subject to dynamic change, with any modification of the local environmental conditions leading to the extension of one type and the recession of another. The relative age of the three formations is uncertain. From a study of its character and composition and of all the factors influencing its distribution, however, it seems clear that the campo cerrado is composed of species belonging to an ancient flora and that it represents a type of vegetation which was once more widespread. Formerly its distribution was continuous. Today only remnants survive with the large tract in central Brazil representing the centre or core area, and the outliers in eastern Brazil and north of the Amazon relict communities. By contrast the mata and the caatinga appear to be of more recent origin. Their gradual extension has been responsible for the gradual recession of the campo cerrado and other types of grassy savanna. How has this come about? The answer must be sought in the geomorphological evolution of the landscape.

Vegetation distribution and geomorphology.—Of outstanding significance again is the fact that the grassy savannas cover the high-level plateaus, whereas mata occupies the valleys and the dissected country in the more humid parts of Brazil; and that caatinga scrub characterizes the low-lying level terrain of the arid north-east, whereas caatinga forest or even dry mata covers the slopes of the serras and campo cerrado occurs on the higher taboleiros.

Everywhere the plateaus represent peneplains or pediplains, the end product of an old cycle of erosion. By contrast the hilly lands represent dissection in a new cycle. As this proceeds the level plateaus are being consumed. Over much of the northern part of Brazil the surface features appear to result from the processes of pediplanation* propounded by L. C. King,[22] with dissection proceeding by headward erosion

* This envisages at least two surfaces, an upper and a lower, separated by a scarp which, under the influence of headward river erosion, is in process of retreat. Every rise of the land relative to sea level, *i.e.* base level (and King believes that continental uplift has occurred several times), initiates the development of a new surface which gradually eats its way inland. Thus a series of such surfaces succeeding one another in time and development may appear, each growing by encroachment upon the features of its predecessors and in turn being encroached upon by the features of the succeeding cycle as headward erosion brings about the retreat of the scarps. King recognizes five cyclic land surfaces in eastern Brazil giving them the names, in descending order, Gondwana, post-Gondwana, Sul-Americana, Velhas and

up the valley and scarp recession at the margins of the plateaus. As it does so the level terrain is replaced by sloping ground, the soils and drainage conditions are improved, and the micro-climatic conditions ameliorated. So in the more humid parts of tropical Brazil, as the plateaus recede the conditions become less favourable for the species of the campo cerrado which is invaded by pioneer forest species. This occurs as soon as the level surface gives way to a sloping one. The cerradão may represent a transition stage which, however, is usually short-lived. In the light of this sequence the sharp boundary between campo cerrado and mata, the occurrence of both types of vegetation in the same climatic zone in the eastern coastal belt, the presence of campo cerrado over the tongue of country forming the watershed between the Rio São Francisco and the Rio Grande, and the occurrence of the greatest tract of grassy savanna over the highest and most extensive plateaus in central Brazil are all readily explained. For under the current cycle of erosion dissection is most vigorous in the coastal areas. As it proceeds from the coast inland, so the mata is extending up the river valleys towards the interior. At the same time, however, as scarp recession and pediplanation proceed, the younger and lower pediplains are growing at the expense of the older ones and are advancing towards the interior. As they do so the vegetation formations extend landwards in sympathy with them. In north-east Brazil the growth of the younger and lower pediplains is bringing about an extension of the area subject to acute aridity. Consequently there the caatinga is advancing at the expense of the campo cerrado.

The relationship propounded between the distribution of the major vegetation formations and the geomorphological evolution of the landscape may be demonstrated by more detailed reference to some of the areas subjected to close study. Of the level surfaces involved, some of those in the area east of the Goiás/Minas Gerais border have recently been dated by L. C. King, and others farther west have been studied by Brazilian geomorphologists. In all areas, the dating ascribed to the level peneplains or pediplains lends support to the contention that, according to whether the climate is humid or arid, either the mata or the caatinga is advancing at the expense of the grassy savanna.

The relationship between vegetation and geomorphology is very striking in Minas Gerais, where campo cerrado covers the level chapadões which form the watershed between the Rio São Francisco and the Rio Grande and gives way to forest in the belts of hilly country at their periphery and along the valleys cutting back into them (Plate 17). Developed over Cretaceous sandstones the surfaces of these chapadões have recently been ascribed to a Gondwana (Jurassic) cycle of erosion by L. C. King, who considers, further, that the valleys and the belts of hilly country have been and are being fashioned in later cycles which he dates as post-Gondwana (mid-Cretaceous) and Velhas (later Tertiary). Erosion in this later cycle has almost completely consumed the surface of an intermediate Sul-Americana cycle (Miocene or mid-Tertiary) and has uncovered Silurian schists which given an adequate slope weather to soils capable of supporting mata. In this region the mata is clearly advancing at the expense of the campo cerrado as the older peneplains or pediplains are being destroyed.

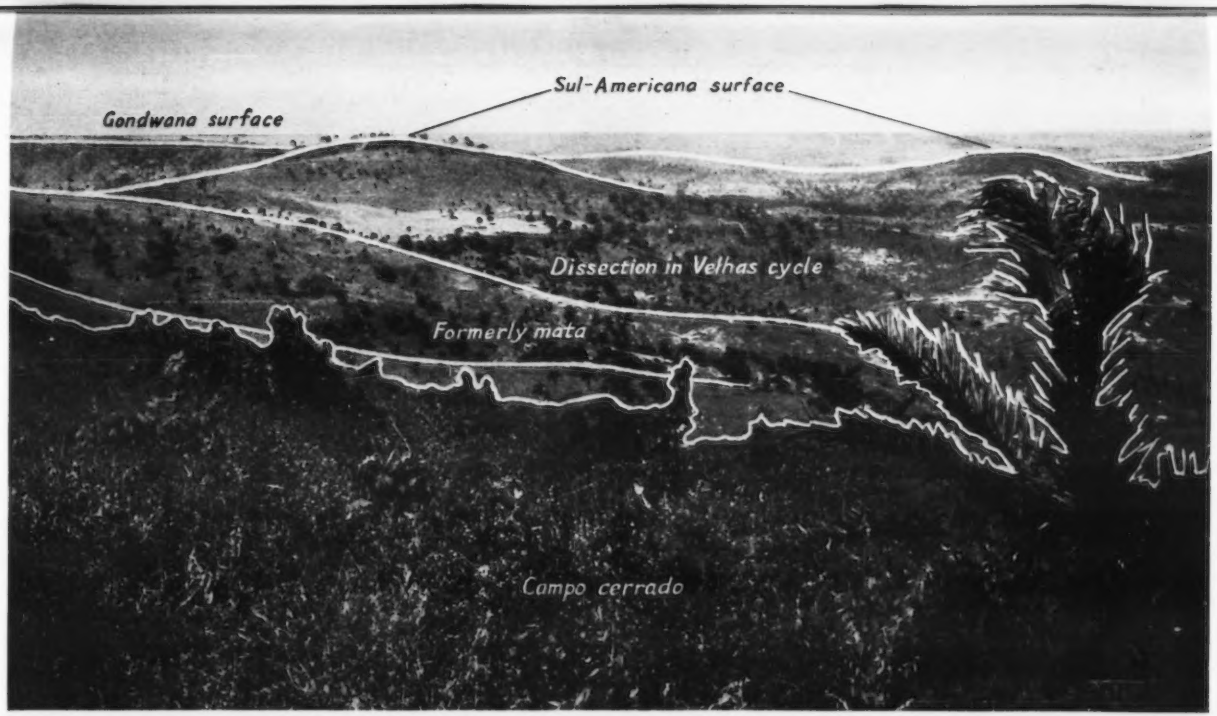
In Goiás and the Mato Grosso, where the grassy savannas achieve their greatest extent, their distribution is coincident with the level chapadões which Brazilian

Paraguaçu. The first named surface receives its name because King believes that it was cut across the old continent of Gondwanaland. Both the Gondwana and the post-Gondwana surfaces have their counterparts in Africa. In early Cretaceous times monoclinal flexuring along the east coast of Brazil and along both the east and west coasts of southern Africa inaugurated the post-Gondwana cycle which, however, was short-lived and produced only an incomplete planation; in Brazil surfaces attributable to this cycle are preserved only in a few localities. In late-Cretaceous times, however, the break-up of Gondwanaland ushered in a long period of denudation which produced the Sul-Americana surface of Brazil, which is considered by King to be comparable with the African surface of Africa. Continental uplift in Tertiary times initiated the Velhas cycle in Brazil and the Coastal Plain cycle in Africa and further uplift extending into the Quaternary period inaugurated the Paraguaçu cycle of Brazil which is comparable with the Congo cycle of Africa.

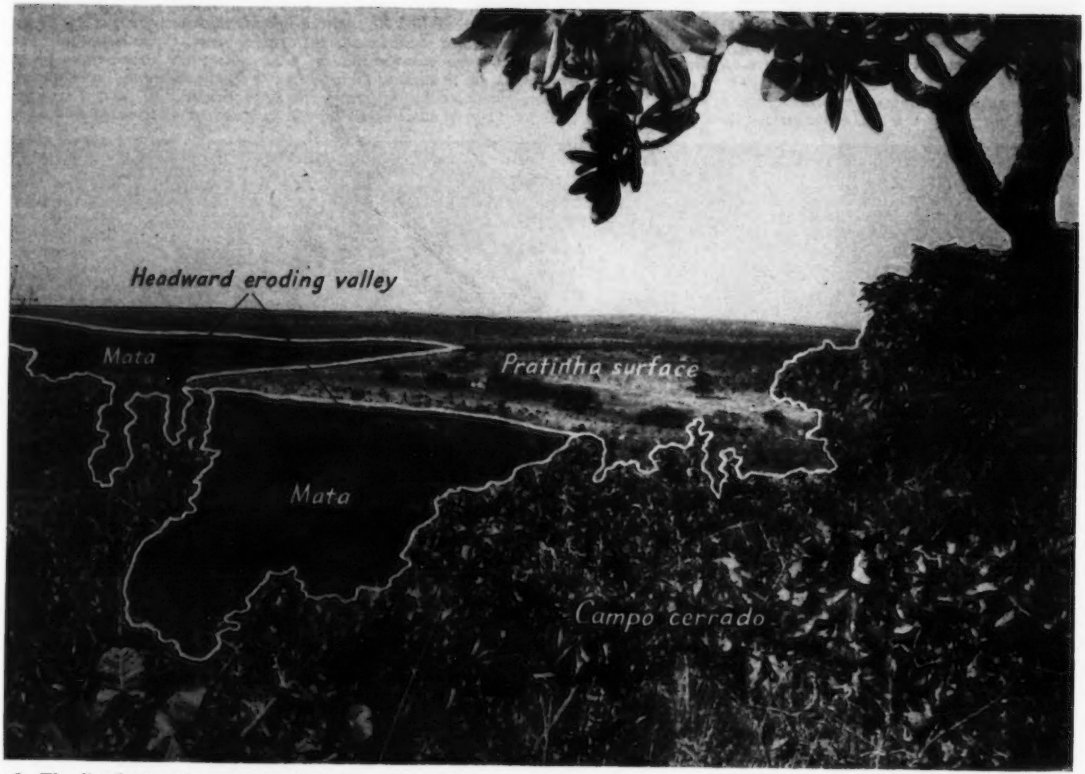
geomorphologists believe represent an erosion surface of post-Rhaetic but pre-Cretaceous age. In Goiás this surface, called by them the Pratinha surface, truncates highly inclined rocks dating back to the pre-Cambrian period. Standing at an average elevation of 1000 to 1300 metres (3000 to 3900 feet) it may be the equivalent of King's Gondwana surface farther east. Between Goiânia and Anápolis it is in process of active dissection. Here the relationship between vegetation and geomorphology is very striking, for everywhere the level remnants of the Pratinha surface carry some form of grassy savanna, whereas along the valleys of the rivers cutting into it the vegetation changes abruptly to mata (Plate 18). As in Minas Gerais, here also the mata is clearly advancing at the expense of the campo cerrado.

The most convincing relationship between the distribution of savanna and mata and the geomorphological evolution of the landscape, however, occurs in the western part of the Mato Grosso where grassy savannas cover two extensive peneplaned surfaces separated from one another by a wooded escarpment which, in places, is fully 2000 feet from foot to crest. The two peneplains are cut across rocks of very different character and characterized by soils of somewhat different composition. The higher of the peneplains is the Chapada de Guimarães, east of Cuiabá. Developed over Devonian sandstones and shales, it has been tentatively correlated with the Pratinha surface of Goiás and Minas Gerais. Standing at an average elevation of about 1000 metres (3000 feet) it carries a savanna vegetation which grades from campo cerrado at its periphery to campo limpo in the centre. The vast extent of the Chapada de Guimarães is considered to be due to the preservation of the peneplain over a wide area. It is, however, being consumed in a current erosion cycle and, significantly, near São José da Serra, where it forms the watershed between the Amazon and Paraguay drainage, belts of mata may be seen following the valleys of the headstreams of these great rivers eating back into the plateau surface (Plate 19). Westwards the Chapada de Guimarães is separated by the great escarpment known as the São Vicente escarpment from the lower peneplain known as the Cuiabá peneplain which is cut across highly inclined pre-Cambrian phyllites and gneisses. This has an average elevation of 250 metres (750 feet) and, since horizontally disposed Devonian sandstone may be seen overlying it in the São Vicente escarpment, it has been dated as pre-Devonian. The present surface may, however, represent an exhumed pre-Devonian peneplain which has been exposed as a result of pediplanation in a post-Pratinha erosion cycle and may correspond to one of the later cycles recognized by King in Minas Gerais. Like the Pratinha surface of the Chapada de Guimarães the Cuiabá peneplain is also being dissected in a current erosion cycle. Where the peneplain is preserved the vegetation is characteristically campo cerrado, but along the valleys and up the slopes fashioned in the current erosion cycle there is a change to mata (Plates 20 and 21). The São Vicente escarpment also is forest-clad. Here again, then, the evidence points to an extension of the mata at the expense of the grassy savanna.

In eastern Brazil both the vegetational distributions and the multiplicity of erosion cycles are most complex. The extensive level peneplains or pediplains which cut across Archaean granites in the arid north-east of the country, and are covered by caatinga over vast areas (Plate 22), are believed by King to have been fashioned in a post-Tertiary or Quaternary cycle to which he has given the name Paraguaçu. He believes this cycle to be more advanced in eastern Brazil and particularly in Bahia than elsewhere. Within the caatinga the relicts of campo cerrado coincide with the last remnants of higher taboleiros belonging to Velhas and earlier cycles. Thus the tongue of campo cerrado near Vitória da Conquista occupies surfaces dated by King as belonging to the post-Gondwana and Sul-Americana cycles, whereas the surrounding caatinga covers the Velhas and Paraguaçu surfaces. All these surfaces are cut across Archaean granites. Further north near Tucano "islands" of campo cerrado occur in a "sea" of caatinga. Here the campo cerrado covers small taboleiros which are built of Cretaceous sandstones and represent the last remnants of the Velhas surface which is being consumed in the Paraguaçu cycle. Near the coast, however, where the climate is humid, the onslaught of the Paraguaçu cycle is bringing about the

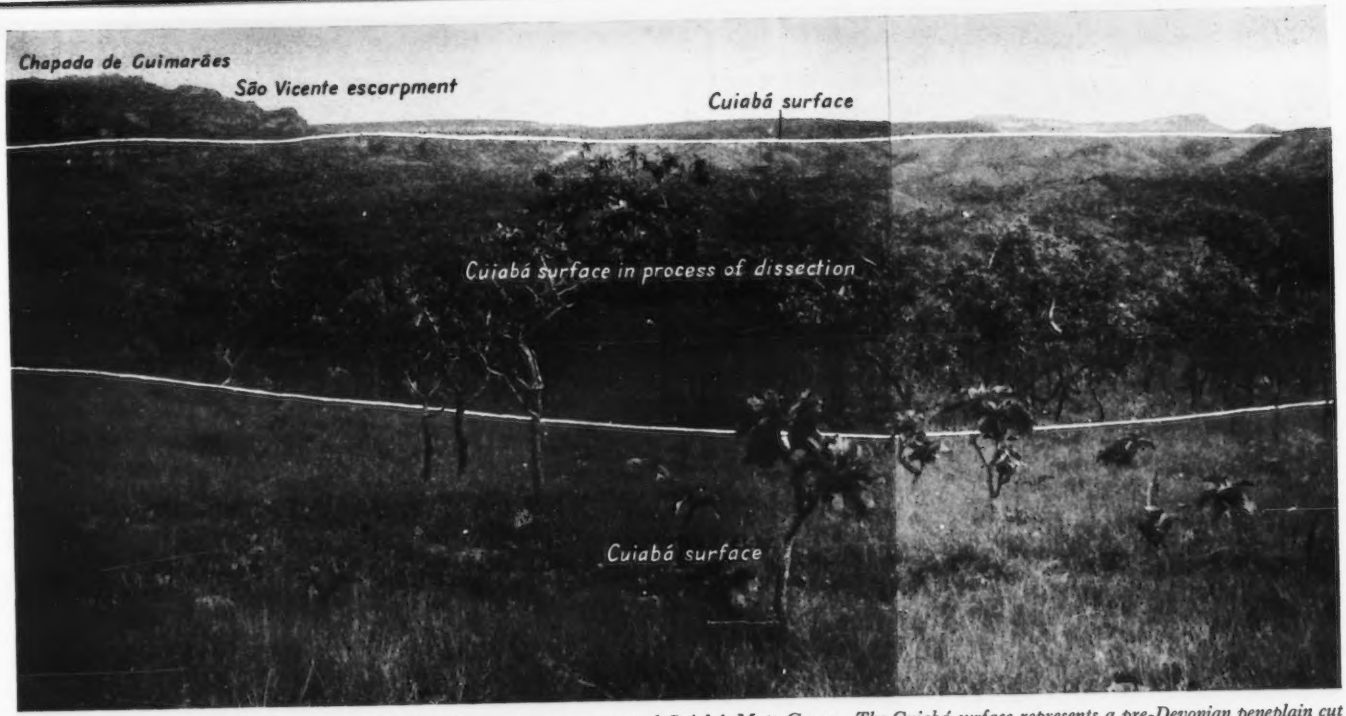


17. Close connection between vegetation and slope is clearly seen in this photograph taken looking north-westwards from a point on the road between São Gotardo and Carmo de Paranáibo, Minas Gerais. Campo cerrado covers the level surface in the foreground and also the high chapada near Carmo de Paranáibo in the background. The undulating country in the middle distance, dissected by a headstream of the R. São Francisco, however, formerly carried mata which has been cleared for pasture and cultivation leaving only isolated trees and palms still standing. The plateaus are developed over Cretaceous and Triassic sandstones; the dissected country is cut into Silurian rocks. The surfaces of the chapadões are considered by L. C. King to belong to the Gondwana cycle of erosion, the valleys to be fashioned in the Velhas cycle; the summits of the hills in the middle distance represent remnants of the Sul-Americana surface

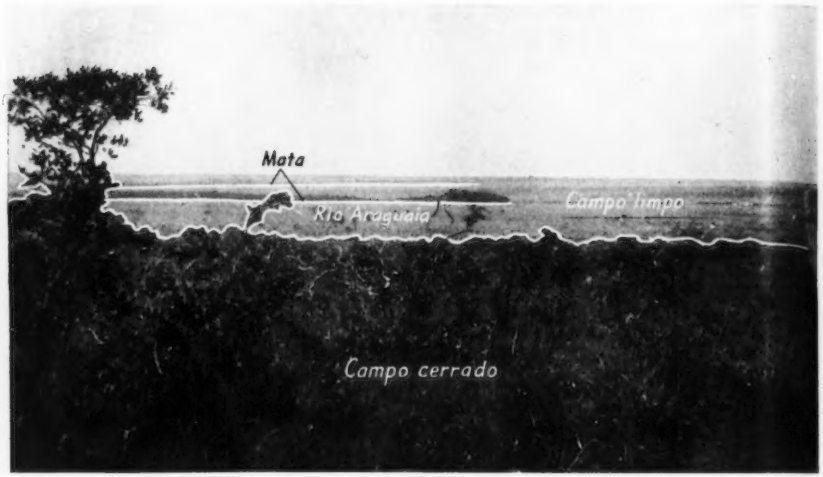


18. The distribution of campo cerrado and mata over the chapadões between Goiânia and Andpolis, Goiás. Note the prescence of campo cerrado over the level plateau surface and the abrupt change to mata along the valley side (left). The tree framing the picture is a **Kielmeyera sp.**

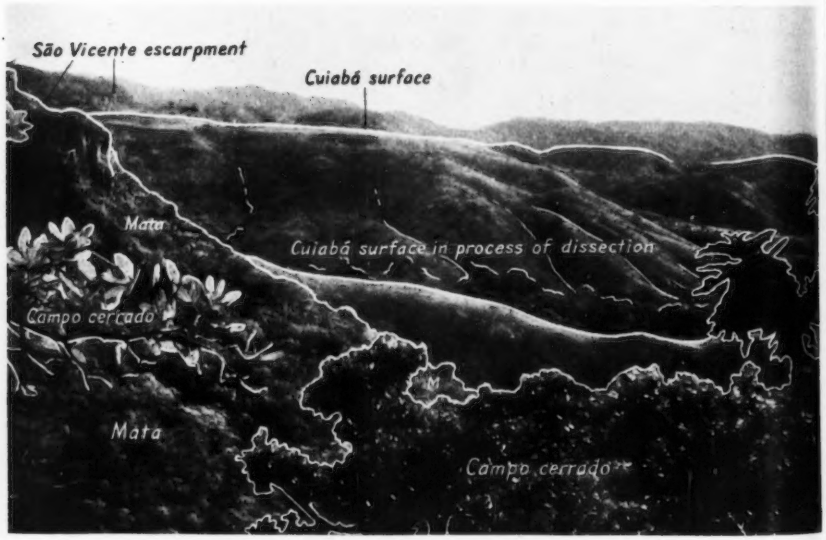
18. *The distribution of campo cerrado and mata is controlled by the soil. Here the change is from campo cerrado over the level plateau surface and the abrupt change to mata along the valley side (left). The tree framing the picture is a* Kielmeyera sp.



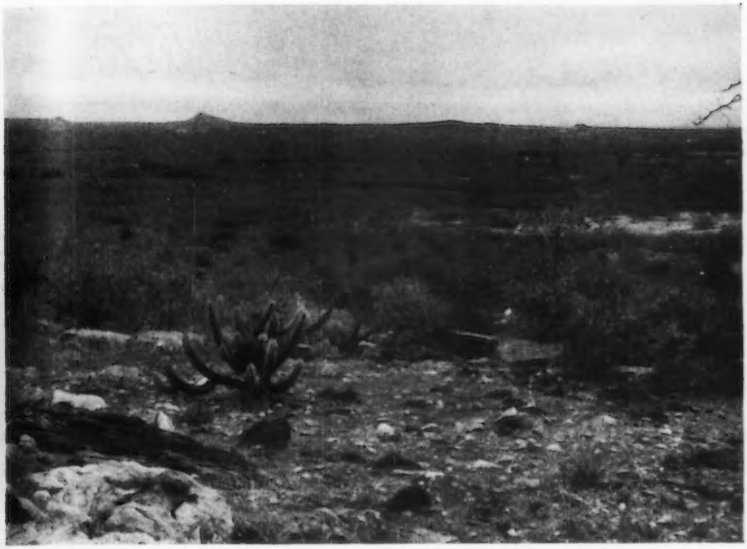
19. *View across the Cuiabá surface towards the São Vicente escarpment east of Cuiabá, Mato Grosso. The Cuiabá surface represents a pre-Devonian peneplain cut across phyllites and gneisses of pre-Cambrian age and now in process of dissection in the current cycle of erosion. The São Vicente escarpment is built of Devonian sandstones resting on granites which here cross the Cuiabá rocks. The escarpment leads up to the Chapada de Guimarães whose level surface has been correlated with the Pratinha surface of Goiás, dated as post-Rhaetic but pre-Cretaceous. Everywhere campo cerrado covers the level surfaces of the old peneplains, as in foreground, whereas forest occupies the dissected country. See Plate 2.*



20. Savanna vegetation on the Chapada de Guimarães east of Cuiabá, Mato Grosso. Foreground: campo cerrado grading through campo sujo to campo limpo in background. The road crosses the watershed between the drainage to the R. Araguaia which ultimately flows to the R. Tocantins and the Amazon system, and that to the R. Paraguay which joins the Parana system. Note gallery forest following a headstream of the Araguaia on left, matched by similar gallery forest following a headstream of the Paraguay, right of the road but not shown on photograph. In this region mata is clearly extending along the valleys at the expense of the savanna as the rivers eat their way headwards into the level plateau surface



21. Dissected slopes of the Cuiabá surface immediately below the São Vicente escarpment, east of Cuiabá, Mato Grosso. Forest is extending from valleys and upslopes as erosion proceeds, whereas campo cerrado covers peneplaned surface from which photograph was taken



22. Caatinga scrub of the Sertão covering the level peneplaned or pediplaned surface near Acari, Rio Grande do Norte. The large cactus, in foreground, is the xique-xique

23. The contact between campo cerrado and mata on the coastal taboleiro north of Olinda, north of Recife. Foreground: campo cerrado covers the level taboleiro built of Tertiary sandstone and characterized by infertile sandy soils and poor drainage; background, mata follows valley of river cutting back from sea. Change from campo cerrado to mata is so abrupt as to be linear, where surface changes from level to inclined

24. Pure grassland, known locally as pantanal, following the R. São Francisco in its upper section between Moema and Melo Viana, Minas Gerais. Campo sujo in the foreground

26. Si
Sertão

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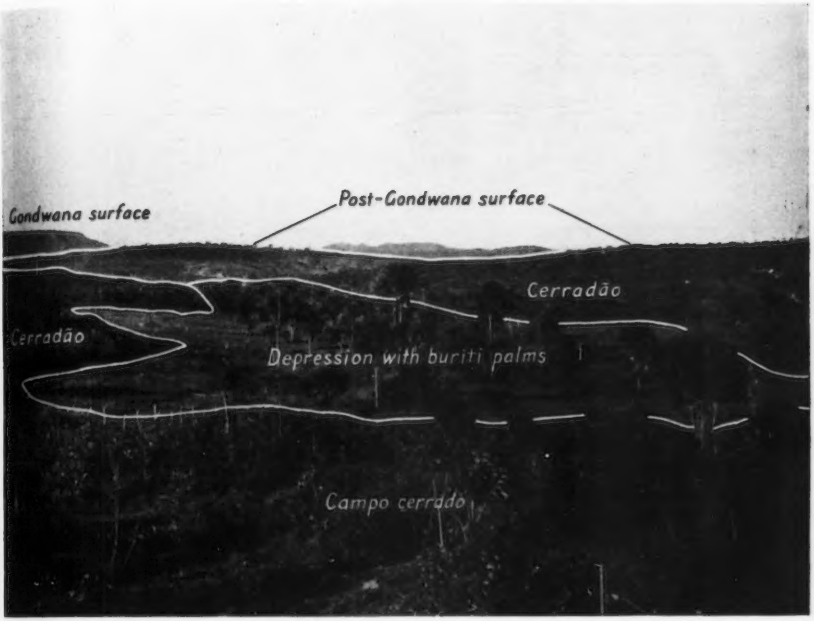
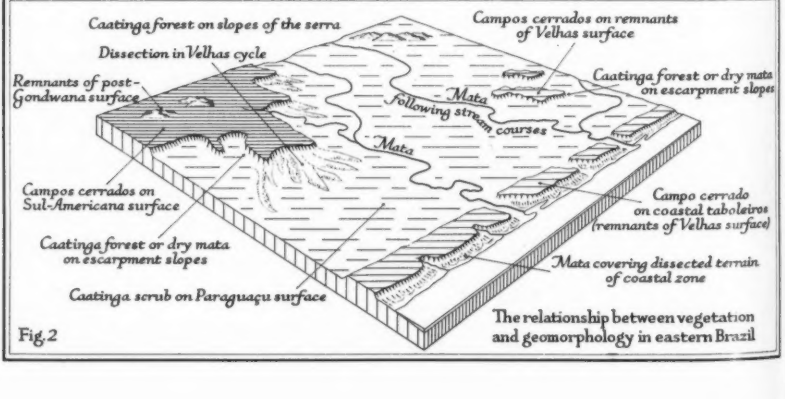


25. Stand of buriti palms in a depression in the post-Gondwana surface of the chapada north of Presidente Olegario, Minas Gerais

26. Stand of carnauba palms, in a slight depression in which the water-table is near the surface; in the Sertão between Serrinha and Caldas de Jorro, Bahia

24. Pure grassland, known locally as pantanal, following the R. São Francisco in its upper section between Moema and Melo Viana, Minas Gerais. Campo sujo in the foreground


Caatinga forest on slopes of the serra
Dissection in Velhas cycle
Remnants of post-Gondwana surface
Campos cerrados on remnants of Velhas surface
Caatinga forest or dry mata on escarpment slopes
Mata following stream courses
Mata
Campos cerrados on Sul-Americana surface
Caatinga forest or dry mata on escarpment slopes
Caatinga scrub on Paraguaçu surface
Campo cerrado on coastal taboleiros (remnants of Velhas surface)
Mata covering dissected terrain of coastal zone
Fig.2

The relationship between vegetation and geomorphology in eastern Brazil

extension of mata up the valleys of the rivers cutting back into the coastal taboleiros. The latter, built of Tertiary sandstones and characterized by infertile sandy soils and poor drainage, carry campo cerrado (Plate 23). Where the rivers have cut right back through the taboleiros their valleys are followed by ribbons of forest extending into the caatinga zone. Everywhere the slopes of the taboleiros and of the serra representing the remnants of earlier erosion surfaces are clothed either with high caatinga forest or with a dry type of mata. The distribution of the various types of vegetation in eastern Brazil, although more complex than in the centre of the country, is thus seen to be related to the geomorphological features in a most convincing way. Figure 2 is an attempt to show this relationship in diagrammatic form.

Evidence of a sequence from grassy savanna to mata and caatinga under conditions which are the reverse of those over the plateaus is found in the pantanal where river deposition is creating new land. There the newest and wettest areas carry pure grassland, which grades to grassland with scattered clumps of cerrado trees on the older flat lands where floods are less frequent and is replaced either by mata or by caatinga, depending on the soil, where natural levees built well above flood level provide well-drained sites. In a similar way along the east coast the ill-drained river flats are occupied by grassland and sedge swamp, whereas mata occurs on the levees and caatinga species are found on the restingas. In the pantanal the rise from the low to the high pantanal suggests that continental uplift has occurred in the past and that the reduction in the extent and degree of inundation following such uplift has been responsible for vegetational change bringing about the gradual replacement of wet grassland and sedge swamp by campo cerrado. Such uplift would accord with King's views on pediplanation.

The role of plant succession.—Within the grassy savannas and the caatinga there are shallow depressions which carry a distinctive vegetation. In its upper reaches on the campo cerrado covered chapada in Minas Gerais, the São Francisco River, for example, is bordered by a broad flat valley which carries a vegetation composed of grasses and sedges and known locally as pantanal (Plate 24). Similar stretches of pantanal occupy flats within the campo cerrado covered Cuiabá peneplain. The vegetation of these areas is undoubtedly seral, a contention which is supported by the succession found around open bodies of water on the Tocantins plateau between Anápolis and Ceres in the state of Goiás, on the chapada near Presidente Olegario in Minas Gerais (Plate 25) and again on the high pantanal in the state of the Mato Grosso. Here an unidentified leguminous plant and the buriti palm (*Mauritia vinifera*) occupy the wettest areas, whereas the drier margins are covered with sedges and grasses. As the swamp dries out so the buriti palms die off. This can be seen taking place near Ceres. In the caatinga zone the shallow depressions occupied by stands of carnaubá palm (*Copernicia cerifera*) are comparable (Plate 26). The vegetation of flats and depressions of this nature is clearly seral. Unless the macro-environmental conditions change it will in time be succeeded by the vegetation characteristic of the surrounding area.

Conclusion

The distribution of grassy savanna, caatinga and mata is thus explained in terms of the ages of their respective floras and the geomorphological evolution of the landscape. The exact distribution at any given period of time is related to the stage in the cycle of erosion, with the campo cerrado representing an edaphic climax on the level plateaus and the mata a climatic climax on those lands which have been given an adequate drainage and good soils as a result of dissection in the current cycle. In a similar way, the caatinga scrub of the Sertão is an edaphic climax and the high caatinga forest a climatic climax. The pantanal is best considered as seral. The dynamic nature of the situation, however, must be appreciated. All the time the surface features are being modified by the agents of erosion and deposition. All the time the climatic and soil conditions are subject to slight but progressive change. And all the time successional and migrational changes are taking place in the vegetation cover with a general tendency for an extension of the mata and the caatinga at the

expense of the campo cerrado and the other grassy savannas. At any time, however, man may upset the equilibrium, and by the use of fire and the grazing of stock he may halt or reverse these changes. It should also be remembered that at any time changes of climate or earth movements may upset the prevailing tendencies as they have undoubtedly done in the past. That, however, is another story. Suffice it to mention only that periods of increased dissection, either associated with a wetter climate or following continental uplift, will favour the extension of forest, whereas increased aridity will lead to the spread of the caatinga, and long periods of stability leading to vast pediplains and worn out soils will favour grassy savannas in the wetter areas and caatinga scrub in the arid ones.

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THE MIDDLE VOLGA—AN EMERGING FOCAL REGION IN THE SOVIET UNION

DAVID J. M. HOOSON

RECENT SPECTACULAR DEVELOPMENTS in Siberia should not eclipse the fact that the bulk of the Soviet population and industry remains west of the Urals. Within European Russia itself no region has its star more clearly in the ascendant today than the Middle Volga, which finds itself possessed of great power resources and good communications, close to the population centre of the rapidly developing Soviet Union (Fig. 1). In contrast to the typical industrial region further east, springing up overnight on practically virgin land, the "new" Middle Volga is being superimposed

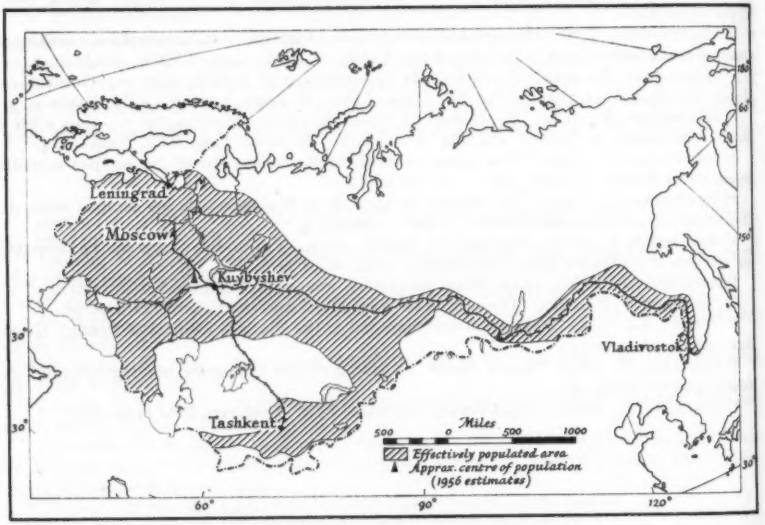

Fig. 1. The Middle Volga in its national context

upon a traditional economy and a long succession of human cultures. Thus a brief regional biography is a desirable preliminary to the main purpose of this paper, which is to attempt a portrait and geographical assessment of the region as it is beginning to play an exceptionally important part in the fortunes of the Soviet Union.

Its extent and physical character.—The core of the region lies about the remarkable loop of the river, centred on the city of Kuybyshev. At this point an east–west axis of population straddling the loop is bisected at right angles by another, following the main course of the river from Kazan' to Saratov. The boundaries of the region are necessarily vague, but a radius of 200 miles or so from Kuybyshev would comprehend it adequately; this is indicated by the blank circle round Kuybyshev in Figure 1.

Physically the Middle Volga is Russia in microcosm—a great river weaving south through the latitudinal warp of the "natural zones," emerging from podzolic forests below Kazan' and descending into semi-desert scrub and *solonetz* soils beyond Saratov. There are extensive areas of tolerably good soils, but their usefulness over much of the region has been vitiated by the deficiency and unreliability of the rainfall and the dessicating *sukhovei* which blows out from the deserts of Central Asia.

Nowhere does the crystalline bedrock come to the surface and the overlying sedimentary formations have proved exceptionally favourable to the occurrence of petroleum, though much less suitable for hydro-electric construction projects. The relief is generally subdued, the chief feature being the asymmetrical valley typical of South Russia, the high right bank of the river forming the edge of the Volga upland, a dissected plateau whose ridges may rise to about 1000 feet above sea level (Fig. 2).

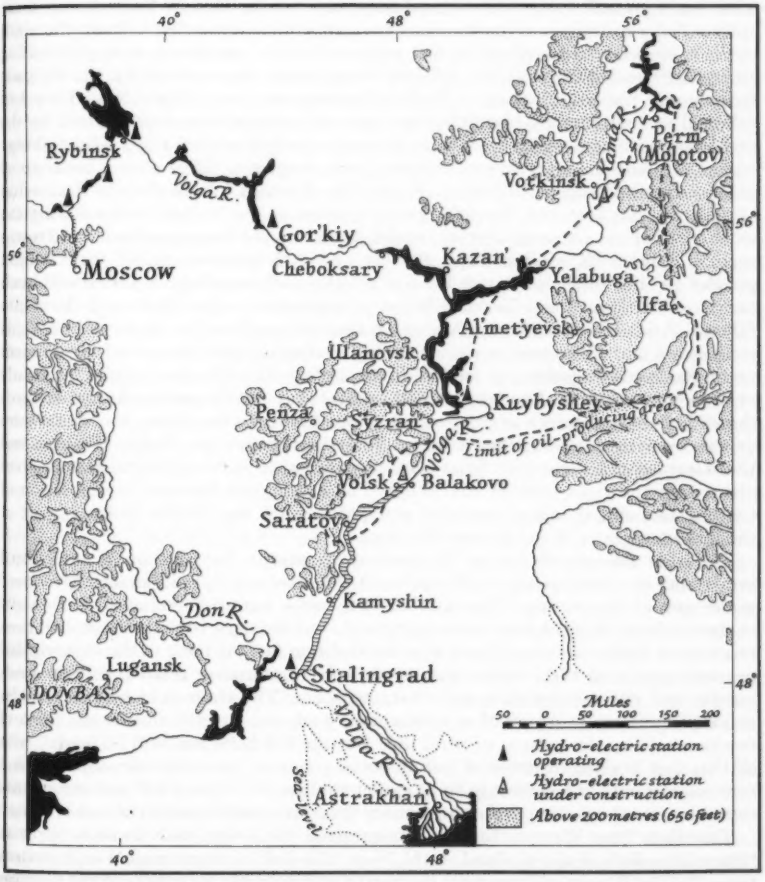

Fig. 2. The Middle Volga in its regional context. Note: The Stalingrad reservoir will be full in 1960–61

The river itself is in the process of being tamed and put to work. Its natural regime is highly irregular, with flood levels in April and May followed by quickly subsiding levels and eventually four or five months' paralysis by ice. As the "Great Volga Scheme" gets under way, and the river becomes a string of lakes (Fig. 2), floods, soil erosion and navigation snags are being mitigated and electricity and irrigation water provided. The spreading water-body in the middle reaches of the river, leading to more intensive use of the water as well as increased evaporation, is

accelerating the fall in the water level of the Lower Volga and the Caspian Sea.[1] The decline in the fortunes of the latter region seems to be inversely proportional to the rise of those of the Middle Volga, but the reasons for this decline are manifold and profound and the trend could only be partially arrested even by the projected diversion into the Volga basin of water at present flowing to the Arctic.

Early settlement.—For many Russians the Volga is "Little Mother" (*matushka*), a symbol linked with nationality and personified in songs and tales. And yet, in what has been called the "ethnological museum"[2] of the Middle Volga (today more aptly called a melting-pot) the Russians are comparative newcomers. From the ninth to the twelfth centuries, when the first seeds of Russian nationality were germinating about Kiev and Novgorod, the Middle Volga lands were settled by the Bulgars, farmers and traders, speaking a Turkish language and practising Islam. They had subdued several Finnish-speaking tribes and all were in turn overwhelmed in the early thirteenth century by the Tatars, who remained in control of the Middle Volga region for over three centuries, adopting the language, religion and commercial practices of the Bulgar civilization. Finally the Russians, under the new leadership of Moscow and Ivan the Terrible, gained control of the Middle Volga during the second half of the sixteenth century, established scattered farming colonies and towns such as Samara (Kuybyshev) and Saratov and attempted to russify their subject peoples. At this time also private Russian merchant adventuring, associated with such names as Stroganov and Yermak, began to penetrate to the Urals and deep into Siberia. Asian invaders like the Mongol Kalmucks continued to batter on the Volga settlements and there were serious revolts directed against the central government under Razin and Pugachov,[3] in which Russian serfs and the Moslem peoples frequently made common cause. Russian political control was finally made effective towards the end of the eighteenth century when, under Catherine the Great, the Turks were driven from the Crimea, thus cutting the links between the Volga Moslems and Constantinople, and colonists from Germany and other parts of Central Europe were planted on the right bank of the Volga. The subsequent Russian incorporation of Central Asia and Caucasia created a new position for the Middle Volga as part of the inner territories of the Russian Empire.

The scene towards the end of the nineteenth century.—In spite of its undoubted importance as a traffic artery, the Volga south of Kazan' was still very much a "frontier" at the turn of the century. The right and left banks were differentiated as markedly in their cultural landscape as in their physical. On the right bank, serfdom had been much more highly developed, and after its abolition in 1861 most of the emancipated peasants remained there under the *mir* (village community) system, so that land-hunger and overpopulation quickly became acute. The three-field system, regular annual migrations in search of supplementary work and an existence on the brink of famine made up the pattern of rural life. But the left bank was still "Siberia" with all that that implied in terms of lack of social cohesion, economic development and communications. It had been to some extent a refuge for "Cossacks" and other fugitives who were beginning to develop a more specialized and commercialized farming.

Travellers from Western Europe characterized the Volga lands in such terms as "the *ultima thule* of the civilized world,"[4] or "the link between ancient and modern times."[5] The Russian villages were contrasted unfavourably with those of the German colonists, and even of the Chuvash and Tatar people with regard to neatness and prosperity, and the towns were described, for instance, as having "a dead-alive look"[6] or as being "in a condition of suspended animation."[7]

There is little doubt, however, that the function of the region as a meeting-place for merchandise from Europe and Asia was enhanced greatly during the nineteenth century with the incorporation of Turkestan and Caucasia into the Empire. The great fair at Nizhni Novgorod (Gor'kiy), where Sheffield steel goods jostled Persian carpets and Chinese tea, was only the most spectacular and highly concentrated of these markets; the Tatar merchants of Kazan' had built up a long tradition of trade with their Moslem kinsmen of Central Asia, and Samara was also belatedly beginning

to realize its strategic location. However, apart from the river itself, transport provision was primitive. It was not until the turn of the century that the Trans-Siberian Railway was being pushed eastwards and the Turkestan Railway south-eastwards, to illuminate and endow with new meaning the Middle Volga's geographical assets in the national context. Among the more important immediate consequences of this development were the increasing geographical division of labour in Russian Asia (especially the export of cotton from Turkestan, with the corollary of greatly increased food imports) and the increasing migration of peasants from the Volga region along the newly blazed trail to the east.

The industrial revolution, which had come, belatedly, to the Moscow region and the Ukraine during the latter part of the nineteenth century, had passed the Middle Volga by. Only about 5 per cent. of the population was employed in industry, and cottage or craft (*kustarni*) industries were much more important than factories (*zavody* and *fabriki*). Of the latter, in 1897, over three-quarters were directly based on agricultural raw material, such as flour milling, distilling, tanning and soap making.[8] In terms of value Saratov, a centre for the Volga German community, was considerably more important than either Samara or Kazan'.[9] The more prominent of the non-agricultural industries were shipbuilding, cement and timber.

An exhaustive study of the Volga basin on the eve of the Bolshevik Revolution concluded that as it was "mainly an agricultural district, the question of the provision of power is not important . . . the use of the rivers for water-power is entirely precluded, not only by the weakness of the current owing to the slight fall in level, but also by ice in winter and drought in summer. Any scheme for the provision of electrical power for industrial use would, therefore, apparently be dependent on steam for its generating force."[10] Apart from some asphalt and shale near Syzran', no minerals, metals or industrial fuel of any kind were obtained from the Middle Volga, and at the time when Baku was the world's most productive oilfield there was no inkling of the existence of the even greater store of oil which extended north-eastwards from the middle reaches of the river.

On the eve of the Second World War.—During the twenty years following the Revolution the Middle Volga was something of a Cinderella among the Soviet regions. This is not to suggest that substantial growth did not take place, but that, in the context of the headlong economic development of the period, the Middle Volga lagged behind the other regions with comparable resources and locational advantages, such as the Moscow region, the Eastern Ukraine, the Urals and the new industrial regions of Siberia. The Middle Volga lands were visited by severe famines in the early nineteen-twenties and by 1926 the industries were just as solidly based on agriculture as they had been in the previous century.[11] It was only in the mid-thirties that foundations were laid for metal-using industries,[12] and even then the emphasis was primarily upon agricultural machinery.[13]

On the completion of the Second Five Year Plan (1937) the Middle Volga still had virtually no power supply of its own. Although the Volga-Ural oil-bearing region had been discovered and was being exploited at scattered points, it only contributed 3 per cent. of the Soviet output[14] and there was almost no refining in the area. Moreover, no work had yet been started on the development of hydro-electric power from the middle reaches of the Volga. Communications were still very inadequate. The Moscow–Volga canal was being completed, but the vital water connection with the Don, which would bring the needed access to coal and steel, had not begun to be cut. The few railways ran west–east, so that during the considerable part of the year when the river was frozen or the water level too low for navigation[15] the cities along the Middle Volga were hardly accessible to each other. However, as the forebodings of war grew in Central Europe, there was a sudden acceleration in the Soviet policy of moving industry and population to the east which, *inter alia*, inaugurated for the Middle Volga the modern phase of development, in which the region has increasingly been "found" in a geographical sense and its relative importance in the Soviet Union as a whole greatly enhanced.

The present transformation.—Only in the last three or four years has it become abundantly and suddenly clear that the character of the Middle Volga and its role in the national scheme have been drastically changed. Although several regions underwent such a metamorphosis during the first decades of Soviet rule, the experience of the Middle Volga in the last two is virtually unique. The rate of economic development, which seems to have been accelerating ever since the eve of the late war, shows no sign of slowing down in the forseeable future. The region has in fact only begun to emerge from the transitional stage between its pre-war character as a largely agrarian backwater, with a serious shortage of industrial power, and its new function as an industrial focus and a national source of power.

Petroleum.—There is little doubt that the Middle Volga is now the greatest powerhouse in the Soviet Union and that this is, above all, what has breathed new life into the region. Petroleum takes pride of place. The war, which highlighted both the approaching exhaustion and the strategic vulnerability of the Baku field, lent urgency to the need for exploiting the known Volga-Ural province. Much exploratory drilling was done during the forties, but by 1950 the Volga-Ural region still contributed little more than a quarter of the Soviet oil.[16] Since then its rise has been phenomenal. By 1956 it accounted for two-thirds of Soviet crude oil output and half the refining capacity, while absolute production figures had risen five-fold since 1950. Moreover, it is now calculated that this region contains over four-fifths of the oil reserves of the U.S.S.R.,[17] the same proportion as was credited to the Caucasus-Caspian fields in 1939. These basic facts are all the more significant since recent policy pronouncements make it clear that the place of oil in the Soviet economy is to be greatly enlarged in the future. Up to the present coal has dominated the Soviet fuel supply situation to the extent of about two-thirds, while oil has even declined slightly in relative importance over the past twenty years. However, the announced aim is to reverse this proportion by 1972, when oil (with gas) is to supply over two-thirds of the Soviet fuel demands.[18]

Within the Volga-Ural region itself, most of the prolific wells and fastest growth rates are now found in the Middle Volga rather than the Ural orbit, although the first producing centres in the thirties were situated on the Ural side. The most remarkable record is being set by the Tatar fields (mainly around Al'met'yevsk) where the daily output has already far surpassed that of Baku, even though production in 1950 was insignificant.[19] Tatar oil is the cheapest in the country and production is apparently being held back because of the lag in pipeline and refinery provision.[20] A very productive group of oil wells is found astride the Great Volga bend near Kuybyshev and Syzran', while the chief focus for gas exploitation is Saratov, whence a pipeline was laid to Moscow as early as 1946. In conclusion, the future for Volga oil (including gas) seems bright when the cheap and plentiful supplies are considered in relation to the long-term priority now accorded to oil in the Soviet economic plans, and to the region's high degree of accessibility to the consuming centres. Already Volga oil is being distributed by pipeline, waterway and railway throughout the industrial centres of European Russia, and a 2000 mile pipeline, already more than half built, is to link the oilfields with the rapidly developing Yenisey-Angara-Baykal industrial region. The dearth of proven oilfields in Siberia so far lends special national significance to this transcontinental connection. The turning of the tables vis-à-vis the Caucasian oilfields and the unbalance between production and refining capacity is highlighted by the fact that the Saratov-Astrakhan pipeline, originally used to carry Baku petroleum products northwards, now takes crude oil from the Volga fields south to the Caspian refineries.[21]

The Volga "cascade."—Although oil is providing the chief stimulus for the present boom on the Middle Volga, and will probably continue to do so for at least a generation, there is little doubt that the "Great Volga scheme," now under way, will prove in the long run to be the most solid and lasting foundation for regional development. Elaborate plans for a series of hydro-electric sites, which would also conserve water for irrigation, iron out the wasteful and dangerous seasonal differences in water level,

arrest soil erosion and improve navigation, were made in the early thirties.[22] Three relatively small stations, at Ivankovo, Uglich and Rybinsk (Shcherbakov), in the river's upper reaches, had just begun to operate before the German invasion. It was not until 1954 that the first-fruits of the resumed post-war development appeared with the opening of the station above Perm' (Molotov) on the Kama, soon to be followed by the one above Gor'kiy at Gorodets and finally by the giant Kuybyshev dam at Zhigulevsk (Fig. 2). The final generating unit was installed at this latter station in 1958, bringing its capacity up to over two million kilowatts, or considerably more than the rest of the installed hydro-electric capacity of the entire Volga basin. The erection of this dam (700 metres long, 80 metres high)[23] in a region of sands and clays was a major achievement, and both the capacity of the station and the reservoir created behind it are at least as large as any in the world. It is already transmitting power to Moscow and to the Urals,[24] and constitutes an important contribution to the unified grid system for European Russia (including the Urals), which is due to be completed in the next few years.[25] The size of the Kuybyshev undertaking is indicated by the fact that it alone accounted for one-fifth of the total Soviet hydro-electric capacity in 1957. In 1960, when the Stalingrad station is expected to be working to capacity, over one-third of the Soviet hydro-electric capacity will be concentrated in those two points on the Volga. In fact the Stalingrad station, whose reservoir will eventually back up as far as Balakovo, and which began producing electricity in 1958, will apparently have an even greater capacity than that of Kuybyshev.[26] Nor will this mark the completion of the "Volga scheme." Dams are now being constructed at Balakovo, above Saratov and at Votkinsk on the Kama (projected capacity about one million kilowatts each), and at some future date it is planned to build dams at Cheboksary and Yelabuga (at the twin northern limits of the present Kuybyshev reservoir). If this total plan is completed (and there have been major changes of policy in the past on the location and feasibility of particular dams[27]), there will be a virtually continuous string of lakes along the Volga from due north of Moscow to Stalingrad and on the Kama south of Solikamsk. In this event hydro-electric capacity in the Volga basin would roughly equal the U.S.S.R. total for 1957 and at least a third would originate in the Middle Volga region. However, in contrast to the case of oil, in which the Volga-Ural region can be expected to increase its share of the national output, the Volga cannot but decline in the regional hydro-electric hierarchy when such provinces as the Angara-Yenisey become properly harnessed.

The industrial revolution.—The industrial personality of the region is being drastically changed in response to the rapid transition from poverty to affluence in its supplies of fuel. The burden under which its industrial development recently laboured is underlined by the fact that, as late as 1955, coal comprised over half of the total fuel used in the Middle and Lower Volga. Moreover, at least half of this wholly imported coal was apparently hauled from the Kuznetsk basin or Karaganda.[28] The new power developments have given birth to several distinct groups of manufacturing industry. First there were the vital precursors, such as cement, ferro-concrete, hydro-turbines, excavators and petroleum-boring and pumping equipment, and the region is becoming more and more important as a supplier of these things for projects in other parts of the Union, especially east of the Urals. There followed the growth of a wide range of industrial derivatives from the massive output of crude oil, such as synthetic rubber and other fibres, fertilizers and alcohol. Finally, the provision of plentiful power in itself has attracted a variety of industries not associated with native Volga enterprises or raw materials, especially in the engineering group (from machine tools to automobiles). Although the lack of coal will discourage the establishment of a steel industry, non-ferrous metal-working, especially aluminium, is beginning to be attracted by the cheap hydro-electric power. The greater Kuybyshev area has proved to be the most powerful magnet for industry—in fact the Kuybyshev *oblast* has shown the fastest rate of industrial growth in the nation since 1940 (Fig. 3).

Farming.—The older industries devoted to processing the products of farming and providing the machinery for their exploitation are continuing to thrive because of the

steady agricultural expansion of the present decade. Though the scale of farming operations has been enlarged through mechanization, extension of the sown area and improved productivity, the dichotomy between the right and left bank territories substantially remains. The Trans-Volga (left bank) lands, generally south of Kuybyshev, form the western limits of the zone of "virgin and long-idle lands," which have experienced a massive expansion of wheat growing in recent years and which are becoming increasingly significant as a means of freeing suitable parts of the Ukraine and the North Caucasus for the change-over to a "corn-belt" economy. Even before the inauguration of the "virgin lands scheme" Saratov *oblast* was an important pioneer in the growing of *durum* wheat, now recognized as having a vital role in marginal dry-farming areas. In 1951 this *oblast* grew as much *durum* wheat as the combined *oblasts* of northern Kazakhstan, and the majority of its wheat was already

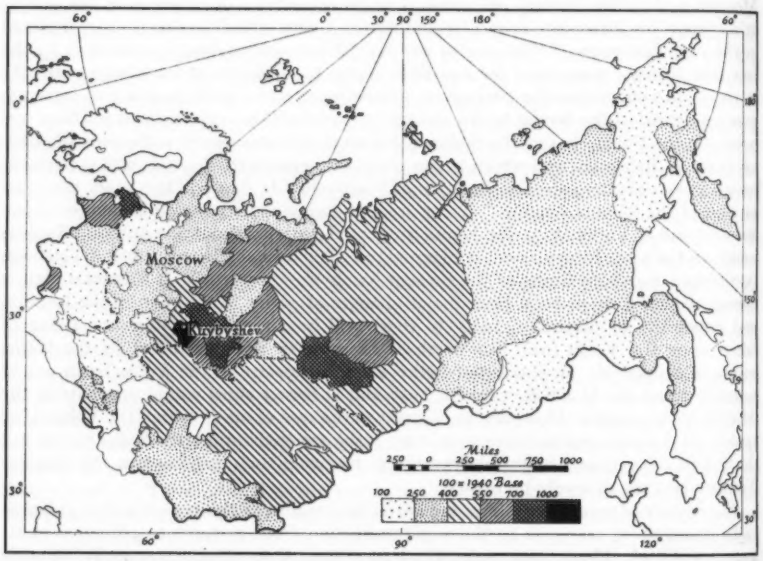

Fig. 3. Growth of industry in the Soviet Union 1940–56. Note: The oblast units are used in the R.S.F.S.R. but elsewhere the S.S.R. figures have been used in the absence of comparable oblast data

of that variety.[29] This region has been the most prominent of the Trans-Volga lands in the expansion of the sown area in recent years. Wheat remains easily the chief product, but extensive ranching (sheep, chiefly for skins and wool, and beef cattle) is also being developed. In the northern and western regions of the Middle Volga, longer farmed and better watered, sugar beet has recently been introduced, while pigs and dairy cattle are multiplying through an intensification of emphasis upon fodder crops. Finally it may be noted that the new reservoirs, though inevitably flooding much former alluvial garden land, are greatly increasing the production of hay for the dairy industry, are being stocked with fish and are storing irrigation supplies.[30] The stage is now set for implementing some of the long-laid irrigation plans in the Trans-Volga lands, which were formerly hamstrung by shortage of power, high costs and industrial priorities elsewhere. Although it had generally been assumed that wheat would be the chief beneficiary of such projects, it has recently been recommended that greater emphasis should be placed on corn (maize) and fodder crops as a basis for animal husbandry, and also on rice, sugar-beet, fruits and vegetables.[31]

Transport.—The Middle Volga region is much more closely knit by lines of communication both internally and externally than it was before the war. The value of the axial waterway has been considerably enhanced in recent years, first and foremost by the opening of the Volga–Don canal in 1952. The significance of the link-up between the Volga system, which carries nearly half the inland water transport tonnage of the U.S.S.R.,[32] and the Black Sea and the industrialized Ukraine can scarcely be exaggerated. Further, the work in connection with the hydro-electric installations is resulting in a reduction of actual navigational distance and a much more stable depth of water, while a steadily increased turnover of freight is leading to the expansion and modernization of port facilities.

No longer has the river a monopoly of north–south communication. During the war a railway was laid parallel to the river on the right bank from Zelenodol'sk (near Kazan') to Stalingrad. Recently a rather more piecemeal counterpart has been built

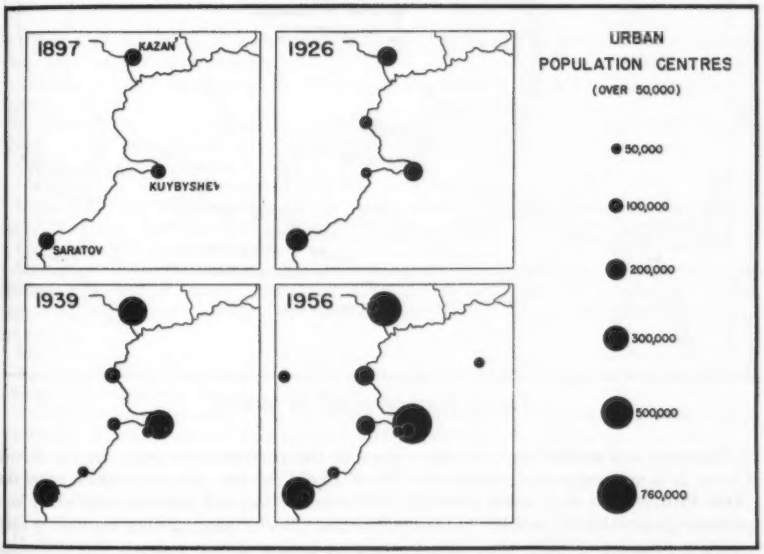

Figure 4

on the left bank from the Middle Kama region, through the centre of the oil country to Kuybyshev and beyond. Saratov is now also connected directly by rail with Central Asia and Kazan' with the Urals, while the Trans-Siberian railroad from Syzran' and Kuybyshev to Novosibirsk has lately been electrified.

Urban growth and the rise of Kuybyshev.—The urban population of the Volga region has grown more quickly than that of any other of European Russia between 1939 and 1956. The rate of growth was twice as high as that of the central industrial district (Moscow region), four times that of the Ukraine and 50 per cent. higher than that of the Soviet Union as a whole.[33] Centrally situated in its region, Kuybyshev and its environs have reflected most strikingly the meteoric rise in the fortunes of this region.

Kuybyshev was estimated in 1956 to be one of the eight largest cities in the Soviet Union. While Kuybyshev doubled its population between 1939 and 1956, none of the other seven cities[34] (all with over three-quarters of a million people in 1956) increased by more than 50 per cent. over this period. Kuybyshev has outstripped the

other two large cities of the Middle Volga, Saratov and Kazan', which were more populous earlier this century (Fig. 4). Several neighbouring "satellite" towns have shared in this growth and there are now about a million people within 30 miles or so of the city centre. Its phenomenal growth is to be understood in relation to its function as the focal point of a region which is rapidly developing its newly found wealth and which itself has a focal role on the national scene. Kuybyshev, on the great loop of the river, is undoubtedly well placed in relation to the new resources and well served by transport links with other parts of the region and the nation (Fig. 5). It was selected as a temporary capital during the war and, if geographers were kings, Kuybyshev might well be voted the "ideal" capital for the Soviet Union of today and tomorrow.

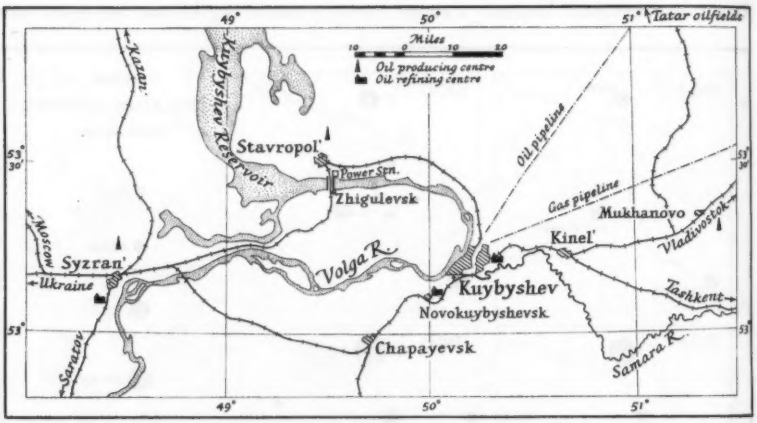

Fig. 5. Kuybyshev and its environs

Summary and conclusions.—In discussions of the current social scene in the Soviet Union it is common to contrast the "New Look" of the nineteen-fifties with the "Old Order" and to discern a radical difference of outlook between the older and younger generation of people. Similarly, the character of geographical regions is very much a product of their time. In the case of industrialized regions this character stems primarily from the nature of the power base. Thus the Kuznetsk region in Central Siberia is an authentic geographical expression of the early Five Year Plan era, when coal and steel were the twin gods. The Middle Volga, in spite of its eventful, sometimes crucial, role in the historical geography of Russia, is still young as an industrial region, and will probably turn out to bear, more clearly than any other Soviet region, the stamp of the industrial revolution of the nineteen-fifties. Having long lain dormant industrially, and having only recently ceased to be a somewhat stationary "frontier," the region began to awake on the eve of the Second World War, and has been growing more important in the geographical scheme of things in the Soviet Union ever since. Its zenith is not yet in sight.

The age of oil in the Soviet Union has only recently been inaugurated, and the Middle Volga has within its orbit the most productive part of the oil-bearing region which has at least four-fifths of the nation's reserves and two-thirds of its production. Hydro-electric power has been proclaimed as an economic panacea from the very early Soviet days, but projects were slow to materialize until the nineteen-fifties, during which capacity has been nearly trebled. The largest hydro-station in the world is in the heart of the Middle Volga region, its generating capacity amounting to a fifth of that of the nation as a whole. In short, the Middle Volga has become the greatest

powerhouse of today's U.S.S.R., with enough to spare for neighbouring regions, and for its own rapidly expanding industries, and this is the fundamental fact underlying the present transformation of the region. Its former dominantly agrarian character has been receding quickly alongside a steady expansion and diversification of farming. Its role as a frontier has given way to one as a bridge and a cross-roads. The fact that it is near the population centre of an economically unified super-state, in which the geographical trend is eastwards away from the older centres, together with the fact of greatly improved transport links with all parts of the nation, provide the key to the superlative value of the new power resources. These are the forces which are combining ever more effectively to create in the Middle Volga a new focal region for the Soviet Union. More specifically they explain the unique growth of Kuybyshev, the heart of the region, since the war, and promise for it an auspicious future.

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SOME PROBLEMS OF SUBSIDENCE AND LAND USE IN THE MID-CHESHIRE INDUSTRIAL AREA

K. L. WALLWORK

INDUSTRIAL DEVASTATION is a major problem of all mining areas which undoubtedly warrants the increasing attention being paid to it by geographers.[1] A geographical approach to the study of derelict land, subsidence, and the disposal of industrial waste is valuable in providing data on the evolution of industrial landscapes and, more important, forms a basis for planned reclamation and restoration. In a paper previously published in the *Journal*[2] the unique subsidence phenomena of the mid-Cheshire saltfield were dicussed mainly from the standpoint of morphology and historical evolution. This short paper forms a sequel in which it is intended to amplify some of the points then raised, but not fully explored, relating to the effects of subsidence on human activities; in particular it draws attention to some new features of the land use problems of the saltfield which it was not permissible to publish when the original paper was prepared in 1954.

Subsidence in its more violent forms is now rarely experienced in mid-Cheshire; the cataclysmic upheavals of the late nineteenth and early twentieth centuries have given way to a more insidious form of subsidence which works stealthily to the same end—dereliction. The change is to be explained largely by the adoption of different techniques of salt working, and by shifts in the location of salt manufacture. An important result of this latter change has been the appearance of subsidence in new areas within the saltfield, mainly near Sandbach. Subsidence was first experienced in this area during the eighteen-nineties, and was probably caused by the pumping of brine at the Wheelock salt and chemical works; it was then relatively insignificant in comparison with the great havoc wrought at Winsford and Northwich, the dominant centres of salt and chemical manufacture. However, after the First World War there were significant changes in the organization and distribution of the mid-Cheshire salt industry, which resulted in the virtual disappearance of salt manufacture from Northwich, the stagnation of the industry at Winsford, and its rapid expansion at Middlewich and Sandbach.[3] The consequent changes in the distribution and character of industrial dereliction can be seen from a comparison of the two maps (Fig. 1 : a, b), which show the several elements of the industrial landscape in 1932 and 1957 respectively.

The growth of the salt industry at Middlewich and Sandbach was accompanied by the formation of several large subsidence "flashes" within the area (Fig. 2a). Most of these were of the trough-like variety associated with natural brine pumping and, as they often lay in the valleys of rivers and small streams, the troughs were soon permanently flooded. It is unfortunate that the growth of salt manufacture in this part of the saltfield antedated the introduction of controlled brine pumping for, although most of the damage has occurred in unpopulated areas, this southward expansion of subsidence is a disturbing feature which shows little sign of abatement.[4]

Just as the expansion of salt manufacture at Middlewich and Sandbach has had unfortunate repercussions, so the almost complete decay of the salt industry at Winsford has appreciably reduced the incidence of subsidence. The great "flashes" to the south of the town have grown but little since the nineteen-thirties (Fig. 1 : a, b) and have begun to silt up in part. In the Northwich area the introduction of controlled brine pumping by the chemical industry, the abandonment of the brine shafts which tapped the bastard reserves in the flooded rock-salt mines, and the contraction of the salt industry have combined to make subsidence much less virile than it formerly was. This does not mean to say that subsidence is no longer a problem over much of

mid-Cheshire: the legacy of ruthless exploitation in the past poses just as many problems as the more recent growth of subsidence in the south-eastern part of the saltfield.

The damage caused by subsidence may conveniently be considered under three main headings. The first category, damage to farmland, may range from the deterioration of pasture through the capillary movement of brine, to the disturbance of the water-table and natural drainage, with the eventual flooding of once fertile land. The process of destruction can best be seen in the vicinity of Sandbach, and at Billinge Green (Fig. 2: a, b, c). It is now less prevalent in the Winsford and Northwich areas, but even here local deterioration and flooding occurs.

The second category covers damage to communications and services. This has long been a problem in mid-Cheshire, especially in the Northwich area, where

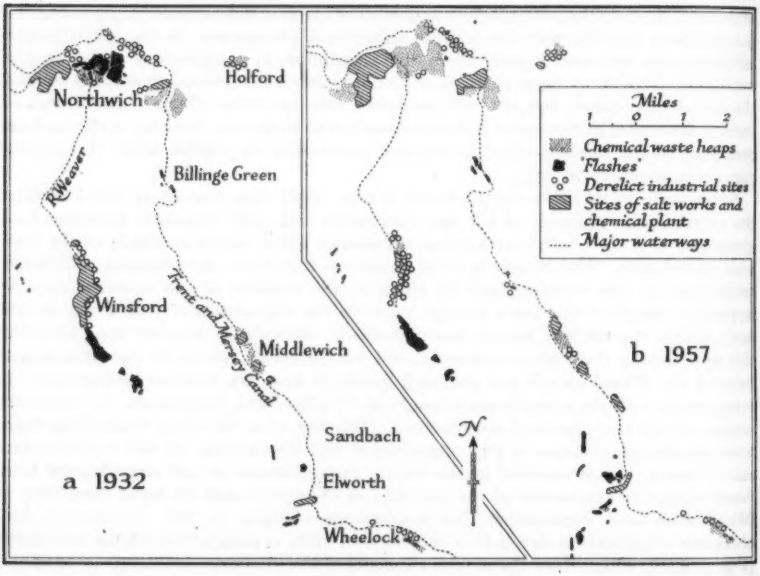

Fig. 1. Subsidence and derelict land in mid-Cheshire (a) *In 1932, map based on the Land Utilization Survey;* (b) *In 1957, map based on field-work*

frequent occurrences of subsidence in the more densely peopled parts of the town seriously retarded the provision of such utilities as paved streets, piped water supply, and main drainage and sewage disposal. It was held that the miraculous absence of zymotic disease from the town was due to the boiling of salt by the open-pan process, which provided a general atmospheric antiseptic; it is certainly remarkable that the primitive utilities of the late nineteenth century, and their constant disruption by subsidence, did not lead to disease of epidemic proportions. Roadways were frequently riven by gullies, and from time to time street levels had to be raised in order to prevent permanent flooding. Although spectacular damage of the kind experienced at the turn of the century no longer occurs, the deterioration of road surfaces and the necessity to lift street levels still provides a minor irritant in the towns of mid-Cheshire.

Of greater importance is the damage caused by subsidence to the canals of the area. The engineers of the River Weaver—canalized in 1721, and a prime factor in the industrialization of the saltfield—have been faced by various technical problems

produced by subsidence for almost two hundred years. Again, the phase of heavy subsidence between 1870 and 1920 brought the gravest difficulties—notably damage to the banks and locks, and to bridges crossing the waterway; today subsidence along the course of the Weaver is relatively slight. The same is not true, unfortunately, of the Trent and Mersey Canal, which by virtue of its importance to the salt trade attracted salt works to its banks at several points—Anderton, Wincham, Marston, Middlewich, Elworth, and Wheelock (Fig. 2: a, b, c). At all these places damage from subsidence has occurred, and in addition the canal traverses the zone of subsidence at Billinge Green, with disastrous consequences. But it is at Wincham and Marston, where the canal passes over several flooded rock-salt mines, that danger from subsidence is most apparent, and where the most serious breaches of the banks have taken place. In an attempt to reduce costs of maintenance along the most severely damaged section of the canal, a new cut was opened in 1958 (Fig. 2c), and it is hoped that this diversion, together with the construction of a new lock at Thurlwood near Sandbach (also constructed in 1958 to maintain the water level), will overcome the most serious problems of subsidence.

Rail communications in mid-Cheshire have also been hindered by subsidence, which has been particularly severe on the main line from Crewe to Manchester, at Elton (Fig. 2a). Here the land beneath the tracks had sunk sixteen feet between 1892 and 1956, and latterly had been sinking at a rate of eight inches per annum. This subsidence caused the destruction of the original viaduct across the River Wheelock, and its replacement by an embankment which was equally prone to subsidence; in 1958 a new "cellular" embankment was constructed, capable of being lifted without disturbing the passage of traffic overhead.[5]

The third category comprises damage to buildings caused by subsidence. Destruction of property on the saltfield is no longer serious, although the legacy of past subsidence remains in two forms: first, the existence of sub-standard brick buildings, damaged but not completely destroyed by brine-pumping subsidence; second, the need to construct new buildings to strict specification on unstable sites, so that they may avoid irreparable damage by future subsidence. Ever since the onset of severe subsidence during the eighteen-eighties attempts have been made to construct buildings which are capable of resisting subsidence. The commonest method has been to erect buildings within a metal or wooden framework resting on a steel or reinforced concrete sill; the entire building can be lifted vertically if subsidence unequally affects the foundations or causes the property to sink below street level. Buildings of this kind qualify for compensation from the local Compensation Board, created by Act of Parliament in 1891 to levy tolls on brine pumpers and to compensate owners of property damaged by subsidence. Ironically, the Board helped to perpetuate problems of derelict land in the worst affected areas by making a "once-for-all" payment while subsidence was still in progress.[6]

Northwich is the main centre in which frame building has taken place, and the character of the town has changed completely in the past fifty years or so, as modern buildings—their framework often camouflaged in the Tudor style of black and white architecture—have taken the place of earlier brick-built properties which were destroyed or damaged by subsidence. Unfortunately most of this rebuilding has been piecemeal, and the opportunity thus offered to replan the town centre has never been taken. A recent proposal to raise the level of the main street of the town, in order to avoid a repetition of the severe floods of February 1946, has now been shelved indefinitely; so that piecemeal rebuilding, and the construction of "temporary" structures on sites affected by subsidence, still continues, and gives the town an appearance of chaotic impermanence. Many of the cleared sites remain open scars in the urban fabric; others are colonized by random factory building, and relatively little central redevelopment of housing has taken place, largely on grounds of excessive costs of building. Instead, housing estates have been built off the saltfield and outside Northwich itself, causing a steady migration of population from the central area, and thereby creating a "dead heart" of enlarged proportions. Thus the

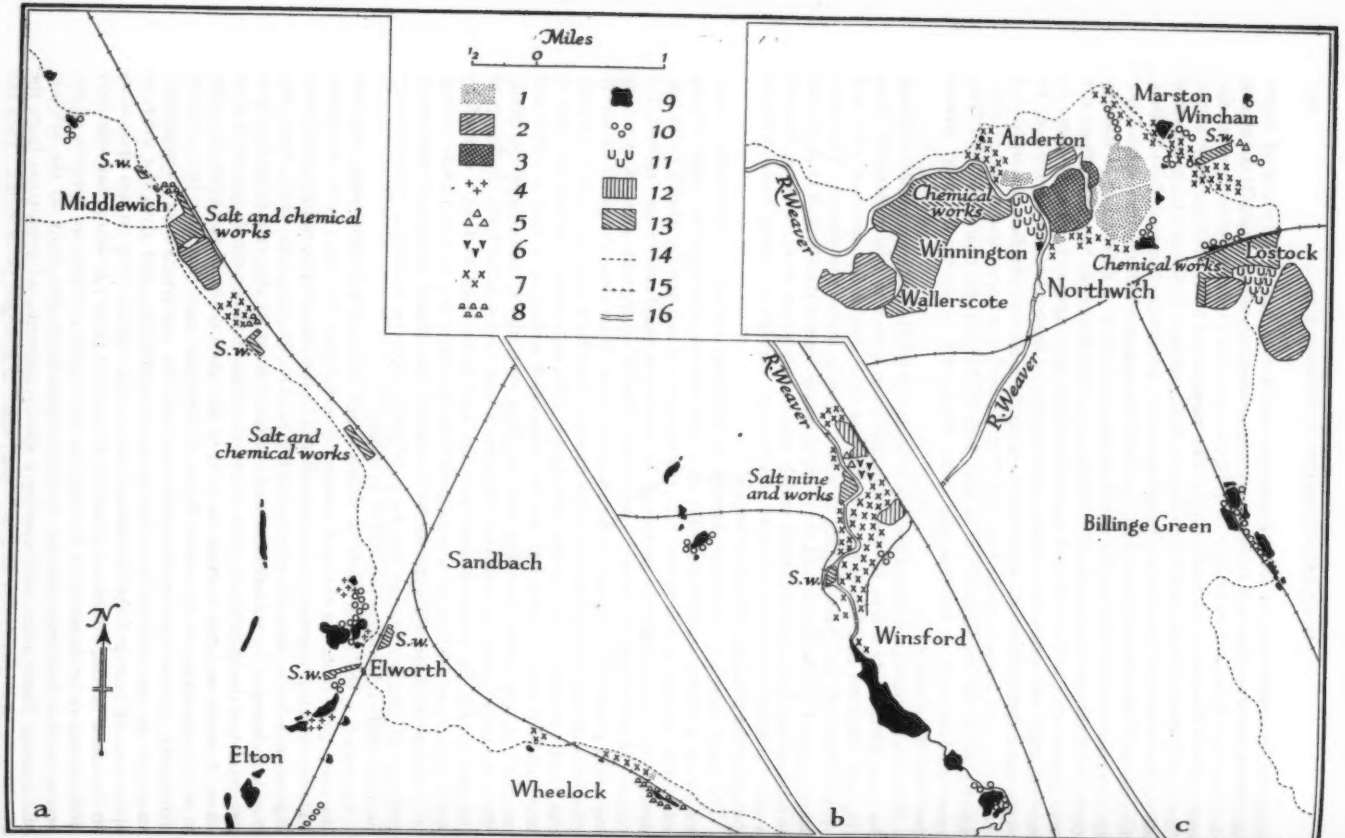

Fig. 2. Subsidence and derelict land in 1959. (a) in the Middlewich–Sandbach area; (b) in the Winsford area; (c) in the Northwich area. Map

urban landscape and modern settlement pattern of the area is just as much a product of subsidence as the dreadful derelict environs of the town.

In spite of the great damage wrought by subsidence and the parallel decline of the salt industry in the northern half of the area, mid-Cheshire still retains its significance as a salt-working district and as an industrial region of national importance. The paradox is explained by the growth of chemical manufacture on the saltfield. In 1873–4 Brunner and Mond, requiring for their new ammonia-soda works a site which could conveniently be supplied with brine, established their factory at Winnington[7] (Fig. 2c). Ironically the works was built on the fringe of the saltfield, so that although supplies of brine were conveniently close at hand the greater part of the site was not underlain by rock-salt and brine, and was therefore free from subsidence. Thus the great industrial complex that has grown at Winnington has always been free from the subsidence which has done much to hasten the destruction of the salt industry locally. To add to the irony of the situation the chemical works derived great benefit from the proximity of subsidence derelict land, for it provided a cheap and convenient dumping ground for chemical effluent. Indeed, the presence of this capacious site for the disposal of waste was a significant, if fortuitous, factor in the success of Winnington Works; the lack of similar facilities proved a severe handicap to many other chemical works established on the saltfield.

The Northwich area, in common with many others in which extractive industries are dominant, has two conflicting problems of land use: one, already noted, is the presence of subsidence "flashes" formed by various agencies during the working of rock-salt and brine; the other is the need to dispose of large quantities of industrial waste—in this instance lime-waste, a useless by-product of distillation in the ammonia-soda process, which is produced at a rate of three-quarters of a cubic yard for every ton of alkali manufactured. The existence side by side of holes in the ground and high waste-heaps is a common enough feature of many mining areas; the paradox persists because of economic rather than technical limitations. In mid-Cheshire the problem has never been acute, largely because the waste product is liquid when it leaves the chemical works, and can be pumped cheaply and efficiently into the adjacent "flashes." Nevertheless, the acreage available of this type of land is not unlimited, and from time to time alternative techniques of disposal have had to be devised.

Symbols for Fig. 2: a, b, c *opposite*

1. *Chemical waste on land affected by subsidence (mainly "flashes")*
2. *Chemical waste on sound land, formerly agricultural*
3. *Chemical waste on land marginal to "flashes," now mainly covered by rough vegetation*
4. *Salt works' waste (lime and solid material) on land affected by subsidence (mainly "flashes")*
5. *Salt works' waste on sound land formerly agricultural*
6. *Salt works' waste on derelict industrial sites*
7. *Derelict sites of salt and chemical plant, now mainly covered by rough vegetation*
8. *Abandoned chemical waste-heaps on sound land, mainly covered by rough vegetation*
9. *Subsidence "flashes" (areas of permanent flooding)*
10. *Areas in which subsidence has caused temporary or seasonal flooding and permanent degeneration of vegetation cover*
11. *Former areas of chemical waste disposal restored by re-seeding of high quality grass sward*
12. *Former areas of industrial dereliction restored to agriculture*
13. *Major sites of salt works (S.w.) and chemical plant*
14. *Canals*
15. *Canal "new cut" (1958)*
16. *River Weaver navigation*

Fig. 2. Subsidence and derelict land in 1959. (a) in the Middlewich–Sandbach area; (b) in the Winsford area; (c) in the Northwich area. Map

Lime-waste was dumped initially on the subsiding water meadows above Winnington Works; this site was eventually embanked and the lime-waste reservoir (or "lime-bed") progressively rose to the height of the steep sided bluffs behind, thus forming an artificial cliff overlooking the Weaver valley. Lime-waste was also dumped into Witton Flash, which was progressively filled with a mixture of liquid and solid industrial waste. The two large "flashes" to the east—Ashton's and Neumann's—were not used for lime-waste disposal until 1938 and 1942 respectively. Legal difficulties over the tenure of the "flashes" may have retarded their use for this purpose, for part of the flooded area belonged to Brunner, Mond and part to the Salt Union.[8] Whatever the reason for it, the "flashes" ceased to be the principal dumping ground for lime-waste during the nineteen-thirties, and an alternative method of disposal was employed.

The disposal of lime-waste on stable agricultural land had already been carried out on a small scale by Brunner, Mond at their Lostock Works since 1907, and a second lime-bed had been constructed there in 1919. But the construction of a large lime-bed at Wallerscote Works in 1937 (Fig. 2c) marked an entirely new departure in waste disposal, for this plant, together with Winnington Works, had previously sent all its effluent into the "flashes." The disposal of waste on agricultural land was deplorable both on economic and on aesthetic grounds, for whereas the pumping of waste into the "flashes" might eventually improve a ravaged landscape, the presence of grey-walled reservoirs filled with slimy white mud, towering over the countryside, was anything but pleasant. Even the acquisition of Neumann's and Ashton's Flashes did not entirely solve the problem, for now the output of the chemical works was progressively increasing, and it became apparent that neither the derelict land nor the existing lime-beds were capable of absorbing the increased flow of lime-waste.

The post-Second World War expansion of the chemical industry aggravated an already serious land use problem. It was clear that lime-waste disposal was either going to ruin irreparably the landscape of mid-Cheshire, or would strangle the chemical industry if a more satisfactory technique could not be evolved. As an interim measure the lime-beds at Wallerscote were extended in 1949; to illustrate the magnitude of the work involved, it should be noted that the solid material used in the construction of the retaining walls was blast furnace slag brought from a steel works at Hollins Green (Irlam), seventeen miles away, at a cost of over £50,000.[9] In 1953 the lime-beds at Lostock Works were also extended, by which time some 268 acres of former agricultural land were under lime-waste in the Northwich area (Fig. 2c and Table I).

In addition to these extensions an attempt was also made to increase the capacity of Neumann's and Ashton's Flashes, by the construction of an embankment to seal them off from Wincham Brook which had hitherto caused periodic disruption by flushing out the lime-waste in time of flood. In constructing this embankment over 600,000 tons of slag were brought from Hollins Green, at a cost of about £250,000. In addition to raw materials and constructional costs the work also involved the diversion of Wincham Brook, and the building of a new road between Wincham-Marston and Northwich, to replace that which had previously run precariously across the "flashes." Even this large-scale civil engineering project did not provide a satisfactory temporary solution to the problem of lime-waste disposal, for in 1954 yet another lime-bed was built on stable land at Dairy House Farm, to the north of the "flashes" (Fig. 2c). By 1957 some 618 acres of land in the Northwich area were under lime-waste, and of this only half was affected by subsidence (Table I). For purposes of comparison it should be noted that roughly 400 acres of land were occupied by the chemical works themselves, 1250 acres were mainly built over, and 250 acres were derelict in the Northwich area. Thus of a total area of agriculturally unproductive land of 2500 acres, roughly one-third was derelict or under lime-waste.

Several alternative methods of lime-waste disposal were investigated in an attempt to solve this pressing land use problem. They included the manufacture of cement from the lime-waste, which was technically feasible, but economically impracticable, and the dumping of lime-waste out to sea, which would have involved the use of a

TABLE I

DERELICT LAND IN THE NORTHWICH AREA 1932–57

	Acreage 1932*	*Acreage* 1957†
(*a*) Lime-waste		
Lostock Works	134	163
Wallerscote Works	—	105
Dairy House Farm	—	32 (*a*)
Total on stable land	134	300
Neumann's-Ashton's	—	159
Witton	54	97 (*b*)
Anderton-Winnington	42	62 (*b*)
Total on subsiding land	96	318
Total lime-waste	230	618
(*b*) Other derelict land		
i. Subsidence derelict	232	53 (*c*)
ii. Industrial derelict	188	178
[Wincham-Marston	114	94 (*d*)
Lostock	19	19
Anderton	50	50
Northwich	5	15]
Total derelict acreage	650	849

*Areas measured from the Land Utilization Survey map.
† Areas measured from land use map compiled in the field.
(*a*) Not used for waste disposal, but kept in hand for emergency use if disposal of waste at Holford is interrupted for any reason.
(*b*) Both sites now mainly grassed over.
(*c*) The decrease is attributable to the use of land for waste disposal.
(*d*) One 20-acre site destroyed by subsidence.

large fleet of hopper barges and was rejected on grounds of costliness. One suggestion —the pumping of lime-waste to the Mersey estuary fourteen miles away, where the strong tidal scour would sweep it out to sea—seemed to offer a sound solution, but it was strenuously opposed by the various authorities responsible for the maintenance of the estuary. Finally, after much experimental work, a technique was devised in 1953 whereby lime-waste could be disposed of in the disused boreholes on the Holford saltfield.

Holford is the largest productive saltfield in the British Isles, and serves not only the local industry but also that of the mid-Mersey Valley with which it is connected by pipeline. All the brine produced at Holford is pumped by the controlled method, in which fresh water is forced down deep boreholes in order to dissolve the rock-salt, which then comes to the surface as brine. The size of cavity thus formed can be accurately controlled, and great supporting pillars are left between the abandoned cavities in order to minimize the risks of subsidence. In order to do this only one-quarter of the rock-salt in any given area is extracted, and although this presents no grave difficulty at present, it may well be that future generations will have need of the salt left behind. Thus any proposal to fill the abandoned boreholes with lime-waste had to ensure that impurities would not contaminate the rock-salt of the supporting pillars. Such a technique has been perfected; so that it is possible to dispose of the lime-waste underground without prejudicing future supplies of brine, and still keeping the threat of subsidence in check as before. At Holford the extraction of

brine, the disposal of chemical waste, and the pursuit of agriculture can all be carried out free from impediment; in contrast, much of the derelict area to the north of Northwich supports only the scantiest vegetation fringing the grey expanse of lime-waste and it is in every respect barren.

Just as the introduction of controlled pumping has done nothing to solve the problems of subsidence in the old salt working areas so the underground disposal of chemical effluent does nothing to improve the condition of existing lime-beds. However, a parallel programme of land reclamation has commenced with the restoration of some small lime-beds at Lostock and the planting of extensive screens of trees around the "flashes." Lime-waste itself cannot support vegetation because of the impurities which it contains, nor will it ever dry out because its main chemical constituent—calcium chloride—is deliquescent. Thus lime-waste always remains a slimy semi-plastic mud, and only by covering it with solid waste to form a stable carpet will it support vegetation of any kind. With better treatment, such as the laying of a deep fertile topsoil, a good greensward can be established in a relatively short time. This has been done to good effect on the embankments of the various lime-beds, around which screening belts of trees have also been planted; the quasi-rural aspect of these once ugly waste-heaps is maintained by the presence of large herds of sheep which are kept to crop the grass on the steep-sided embankments.

Even where solid waste is the sole material dumped on to the lime-beds, a coarse natural vegetation will soon establish itself; as for example at Witton Flash, where the extensive infilling of solid waste has been rapidly colonized by rough grasses, and by flora such as Golden Rod (*Solidago virgaurea*) and Rose-bay Willow-herb (*Chamaenerion angustifolium*).[10] It is, however, likely that sites of this kind will remain wild and weed-strewn for many years to come; they cannot be used for building purposes for there are no firm foundations and subsidence still takes place periodically. In general, it seems that reclamation must proceed in two distinct stages: first, an aesthetic improvement resulting from colonization by rough grasses and the planting of screening trees; second, a possible return to pastoral farming once a suitable greensward has established itself. Some of the smaller "flashes" might be preserved as bird sanctuaries for they are already the haunt of many rare species[11]; this would not be an innovation, for a similarly flooded derelict area at Ferrybridge (Yorkshire) is already preserved as a nature reserve. Elsewhere in mid-Cheshire, where the "flashes" are not used as waste receptacles, the misfortunes of subsidence have already been transformed into valuable amenities. This is particularly true of Bottom Flash at Winsford, which supports a flourishing yacht club and is pleasantly enough situated to warrant its local title of "The Cheshire Broads."

In addition to the land laid waste by subsidence and the disposal of industrial effluent, derelict industrial sites add to the picture of desolation in many parts of mid-Cheshire (Fig. 2: a, b, c). This is particularly true of Wincham and Marston, where the remains of a once important concentration of salt works litter a landscape punctuated by abandoned mine shafts and subsidence hollows, the whole fringed by a dismal expanse of slimy grey lime-waste. But even here attempts to tidy up the elements of industrial decay, together with the natural regeneration of timber stands, are helping to soften the harsh contours of a chaotically derelict area. At Winsford the almost complete disappearance of the salt industry has left an indescribable trail of desolation along the Weaver Valley, where salt works once crowded cheek by jowl. Abandoned brine shafts, derelict works and warehouses, rotting quays, and mounds of ash and clinker from the old open-pan furnaces stretch along both banks of the river. Although many of the derelict works have been demolished, and tree planting has been carried out in an attempt to screen the acres of brick rubble marking their sites, the general impression is still one of industrial decay. At Middlewich there are the waste heaps of abandoned chemical works, in addition to the lime-beds which lie close to the still active alkali plant. In the Sandbach area there are two major concentrations of industrial dereliction (Fig. 2a). One, at Wheelock, comprises the sites of abandoned salt and chemical works, which have been left untended since the

mid-1930's. The other, at Elworth, consists of "flashes" partly filled with waste from the salt and engineering works near by.

Thus throughout the industrial area of mid-Cheshire dereliction in its various forms still constitutes a major problem. Subsidence may no longer be virulent over much of the region, but its effects are felt with differing degrees of intensity all over the saltfield. The decay of the salt industry has almost certainly reached its nadir, but the derelict sites will remain mute witnesses of former industrial vigour for many years to come. The solution of the lime-waste disposal problem is welcome and timely, but it does nothing to remove the huge lime-beds which already dot the landscape. As in so many industrial areas the legacy of nineteenth century industrial *laissez faire* casts a dark shadow over the modern landscape. Reclamation and restoration are often feasible, but as they normally require heavy capital expenditure for little immediate return improvement schemes are not always carried out. In mid-Cheshire the introduction of new techniques of extraction and waste disposal and the restoration of derelict land have been properly carried out with the financial backing of a prosperous industry—for dereliction is not exclusively confined to areas of industrial decay. The land use problems of mid-Cheshire are unique, and their solution equally so, but much encouragement can be derived from the fact that, given the capital and the desire to reclaim, much can be done to restore an apparently desolate industrial landscape.

Acknowledgement.—The author wishes to thank Mr. A. S. Irvine for information on lime-waste disposal in the Northwich area, and Mr. P. Jackson for drawing attention to recent subsidence in the vicinity of Crewe.

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[1] For an outline account of this work, and a selective bibliography, see T. W. Freeman, 'Geography and planning' (1958).

[2] "Subsidence in the mid-Cheshire industrial area," *Geogr. J.*, **122** (1956) pp. 40–53.

[3] For an account of these changes see "The mid-Cheshire salt industry," *Geography*, **44** (1959) pp. 171–86.

[4] Subsidence, which first appeared on the northern outskirts of Crewe between 1910 and 1920, is now considered a potential threat to the expansion of the town in a northerly direction. Thus not only the salt and chemical manufacturing towns of the saltfield are threatened by subsidence. See also *Minutes of Evidence* taken before the Select Committee on the Cheshire County Council (Brine Subsidence) Bill (E.L.) Session 1951–52.

[5] See *The Railway Gazette*, **108** (1958) p. 536, for an account of the technique employed.

[6] For an account of the legal aspects of the original Act, and its modern successor, the Cheshire Brine Subsidence Compensation Act (1952), which extended the provisions of the 1891 Act to parts of the saltfield outside the Northwich area, see S. H. Brown, "Salt and subsidence," *Town and Country Planning* (1955) p. 419.

[7] For outline accounts of the establishment of the chemical industry see 'The first fifty years of Brunner, Mond and Company' (1923), and J. M. Cohen, 'A life of Ludwig Mond' (1956). A useful, if brief, summary also appears in 'Merseyside, a scientific survey' (1953), pp. 255–8.

[8] The Salt Union was absorbed by Brunner, Mond's successors, I.C.I., in 1937; it is said that the use of the "flashes" for waste disposal was not conditional on the merger, but it is a curious coincidence that the two should occur in conjunction.

[9] The slag was moved by road at a total cost of 6*s* 6*d* per ton; it was the most suitable and the cheapest solid material available in bulk at the time. In 1952, when further slag was brought by road, it cost 7*s* 6*d* per ton, due to higher transport charges. In all 760,000 tons were moved between 1949 and 1952, at a cost of roughly £300,000.

[10] For a full list of the species to be found see A. W. Boyd, 'A country parish' (1951), pp. 230–1.

[11] See A. W. Boyd, *op. cit.*, pp. 100–41, for details of the wild-life on and about the "flashes."

SAND FORMATIONS IN THE NIGER VALLEY BETWEEN NIAMEY AND BOUREM

J. R. V. PRESCOTT AND H. P. WHITE

THE WRITERS have recently carried out field-work in the area of the lower middle Niger and made observations on the sand formations found there. A note would seem appropriate as a corollary to Grove's recent paper on ancient ergs[1] and in view of the absence of any detailed accounts of this area.[2]

The sand formations fall into three sections (Fig. 1). The first section lies between

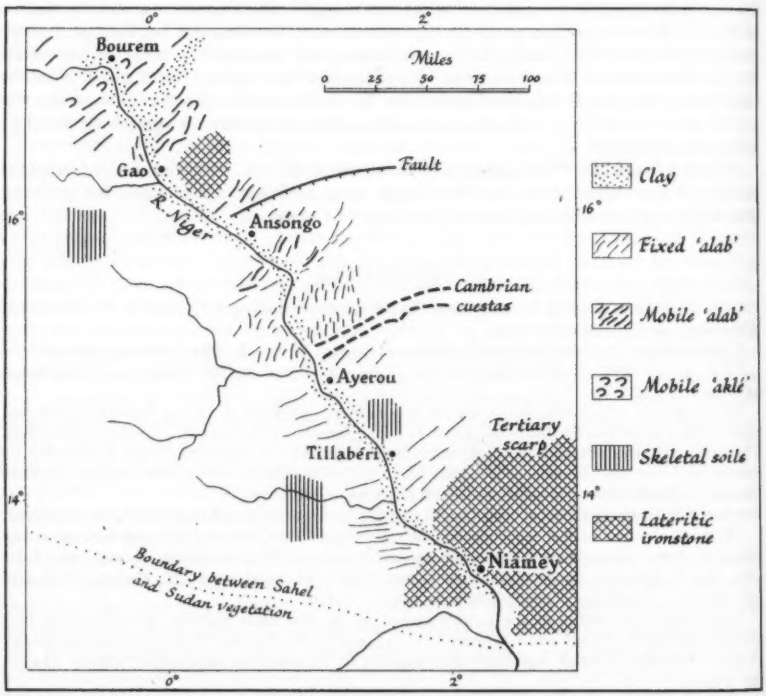

Fig. 1. Surface deposits in the lower middle Niger Valley

Niamey and the two cuestas of massive Cambrian sandstone which are aligned ENE.–WSW., between 12 and 20 kilometres north of Ayerou. Here dunes are rare on the Tertiary sandstone plateaus between Tillabéri and Niamey and only a little more frequent in the tributary valleys. All the dunes examined were fixed by grass and were only recognizable as low ridges, less than 6 metres high, which had evidently been much degraded. All the dunes appeared to be *alab*.[3] North of the sandstone plateau the dunes were more frequent, especially on the west bank of the river where there are fewer outlying buttles to interfere with dune development. The dunes, which were all fixed, were *alab* aligned on an average true north bearing of 270°. The dunes were from 7–20 kilometres in length and about 3 kilometres apart. The intervening areas

were covered with thorn bushes which provided a useful contrast on air photographs with the grass covered dunes (Plate 1). Settlements were frequently located on the dunes.

The second section stretches from the Cambrian sandstone cuestas to the fault which lies 2–3 kilometres north of Ansongo. The dunes here are arranged in four belts 6–15 kilometres wide. In all four belts the dunes are small, usually not more than $1\frac{1}{2}$ kilometres long. The dunes in the two southern bands are aligned on a true bearing of 170°, while those in the two northern bands are aligned 230°–240°. On the west bank of the river south of Ansongo there are some dunes, up to 3 kilometres in length, lying parallel to the river, on a true bearing of 110°, and not more than 5 kilometres from it. While most of the dunes in this area could be classified as fixed *alab* they were generally higher (up to 16 metres) than those of the first section. The areas between the dunes consisted mainly of weathered schists which supported a more open covering of thorn bushes than in the previous section. In most cases there were small patches of bare sand and a few dunes seemed to be mobile, judged by the way vegetation in their path was being buried, while clumps of grass were being left on pillars of sand in their wake. On the other hand, scattered compound farms are frequently located on the fixed dunes. There were also some areas on the road where sand was encroaching. There was very little laterite in this area.

The third section lay between the Ansongo fault and Bourem, where the Niger swings south from its eastward course. As one travels northward it is clear that the proportion of mobile dunes increases and north of Gao they are the rule rather than the exception. This characteristic has also been noted by Capot-Rey and Urvoy.[4] Individual dunes are from 16–23 metres high. With the exception of a few dunes parallel with the river opposite Gao the dunes are aligned on an approximate bearing of 250°. Most of the dunes are *alab* with some *slouk* (Plate 2). *Akeile* make their first appearance but are rare. The areas between the dunes are bare of vegetation and appeared to have reg-like surfaces of ferruginized material. Between some of the dunes there were curious hillocks of compacted sand, darker than that which formed the dunes and containing some silt. Settlement now avoided the dunes and kept very close to the Niger.

It is thus interesting that in the Niger Valley, where one might expect to find more vigorous vegetation, fixing dunes along its course, there are in fact mobile dunes far south of the line suggested by Grove. It may be this anomaly is due to over-grazing by the large herds of cattle which are brought every two days during the dry season to water at the Niger. Our field observations, together with the examination of some of the air photographs of the area, lead us to two general conclusions in respect of the method of using the distribution of ancient ergs in determining past climatic changes.

First, it is impossible to distinguish between fixed and mobile dunes from air photographs unless there is very close ground control. Vegetation on a dune cannot be taken as evidence of stability, nor is it possible to assess the degree of vegetation cover required to fix a dune. Further, certain bare dunes can be fixed, the best examples we saw being opposite Gao on the west bank of the river. They were much redder than most of the dunes examined and, as already recorded, parallel to the river on a true bearing of 150°. We were informed by M. J. E. Dietrich[5] that he had discovered certain bare dunes in the Ansongo area fixed in the lee of slag deposits left by primitive metal workers.

Second, in identifying ancient ergs it is not enough merely to delimit their area, it is essential to identify the types of constituent dunes. This is because there is a growing body of opinion which believes, on the basis of field-work carried out in various parts of the world, that certain types of dunes are capable of being formed under Sahel conditions.[6] Such a dune is the *elb*. Therefore it appears that the existence of *alab* dunes is not sufficient evidence alone of former Saharian conditions. (Under certain conditions too, vegetation may actually assist in the accumulation of sand and the creation of dune-like features.[7]) It would provide confirmatory evidence, however, if other facts indicated a former Saharian climate. On the other hand, *akeile* dunes can only be

formed under Saharian conditions and provide clear evidence of a former Saharian climate where found outside existing Saharian areas. Our experience in Northern Nigeria, and with air photographs of that area, suggest that the longitudinal dunes of which Grove writes are in fact *alab*, which could have been formed under Sahel conditions.

In the absence of *akeile* the only safe conclusion, as far as Hausaland is concerned, is that the boundary between the Sudan and the Sahel, at the time the dunes were formed, may have been 240 kilometres south of its present position. In French West Africa there are few, if any, *akeile* more than 160–240 kilometres south of the present Sahel-Sahara boundary and all the fixed dunes shown on Grove's map are within the present Sahel zone.

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[1] Grove, A. T., "The ancient erg of Hausaland and similar formations on the south side of the Sahara," *Geogr. J.*, **124** (1958) pp. 528–33.

[2] The best general account is by Y. Urvoy in 'Les bassins du Niger,' Paris, 1942, pp. 114–117.

[3] The terminology used throughout this note is that devised by D. Brosset in "Essai sur les ergs du Sahara Occidental," *Bull. de l'IFAN*, **1** (1939) pp. 657–90, and subsequently used by T. Monod in "Majâbat al-Koubrâ," *Mémoire de l'IFAN* **52** (1958), pp. 141–50. The terms used in this note are:—

elb (pl. *alab*): symmetrical ridges of sand parallel with the dominant wind.

silk (pl. *slouk*): longitudinal dunes, slightly oblique to wind direction. Smaller, less regular and less continuous than the *alab*.

aklé (pl. *akeile*): crescentic transverse dunes.

[4] Capot-Rey, R., 'Le Sahara Français,' Paris, 1953, p. 28. "Certes les dunes vives ne sont pas tout-à-fait absentes; de Bourem à Gao, la rive droite du Niger est bordée de dunes aussi nues et aussi dorées que les dunes sahariennes; mais elles sont incarcérées entre des massifs de dunes basses, grises, couvertes d'euphorbes et semées de bouquets d'acacias."

Y. Urvoy, (*op. cit.*, p. 114), describes how the Niger Valley south of Tosaye is, "... encadré . . . au sud de magnifiques dunes vives d'une vingtaine de mètres."

[5] We gratefully acknowledge the help given to us by M. J. E. Dietrich, of the Service de Géologie et Prospection Minière of Dakar, in lending air photographs and maps.

[6] For an excellent summary of these arguments see, T. Monod, *op. cit.*, pp. 160–3.

[7] Bagnold, R. A., 'The physics of blown sand and desert dunes,' London, 1954, p. 184.

The following note is added by Mr. A. T. Grove:—

"I would be glad of the opportunity to comment on some of the points raised by Prescott and White in the paper appearing above. They refer to Monod's remarkably thorough study of the Majâbat al-Koubrâ, published last year; a memoir that provides an excellent model for future work. The dune terminology Monod uses may well be adopted more widely in the future, but Moorish terms are often very difficult to define, and in a short paper a simple description in English gives a more precise and clearer picture. For example, there are several types of *akeile*, and whereas Prescott and White give its meaning as 'crescentic transverse dunes,' Capot-Rey gives *aklé* in his glossary ('Le Sahara Français') as a compact mass of dunes having steep slopes. The word *mreyyé* or *merẽle* seems to be a useful one; it could perhaps be applied to some of the transverse sandy undulations spaced at intervals of about 100–300 metres to which I referred as transverse dunes in north-east Nigeria. They occur very widely in the Sahara; over sandy plains near Tibesti, on the erg of Murzuch, and in the central part of the Majâbat el-Koubrâ from which the word *merẽle* is derived. They have not been described often and their origin seems to be unknown. They might form under Sahelian conditions, but I doubt it.

"The existence of shifting sands between Gao and Bourem to the south of the 150-millimetre isohyet may, as Prescott and White suggest, be the outcome of erosion caused by the many herds gathering near the Niger in the dry season. I remember seeing great numbers of cattle near the 'dune rose' opposite Gao, for example, when

1. *Fixed* elb *north of Tillabéri*

2. *Mobile* silk *south of Bourem*

I passed that way in April 1955. Other examples of active dunes within the Sahelian zone occur about 80 kilometres west of N'Guigmi, on the ridge marking an old shoreline of Chad, which forms a dry routeway covered with cattle tracks, between swampy fixed dune-fields on either side of it.

"It is not suggested here that *all* the sand on the move in the Sahelian zone has been released by accelerated erosion but, having recently studied air photographs covering some thousands of square kilometres of the Saharian fringes, I am impressed firstly by the relatively sudden improvement of the plant cover from north to south of a zone about 50–100 kilometres wide near the 150-millimetre isohyet, secondly by the general lack of indications of sand on the move to the south of that isohyet, and thirdly by the numerous gullies in the vegetated dunes. These gullies, it might be argued, could have been cut in a phase more humid than the present one, but the fact remains that they have not been filled in by blown sand. These observations accord on the whole with the general picture I presented in my paper, and I am still inclined to agree with Capot-Rey's conclusion in 'Le Sahara Français' (p. 158) that the Sahelian dunes were formerly living dunes which have been fixed, and in places refashioned, in the course of a more humid period. Nevertheless, Monod's insistence that an answer has not been given to the question as to whether a system of longitudinal dunes can or cannot be built in a Sahelian environment carries much weight behind it, and research is needed into this subject.

"The southward extent of vegetated dunes has been checked on air photographs of the main areas where young sediments have accumulated extensively over areas south of the Sahara. In the eastern part of Chad, longitudinal dunes (probably *alab*—the *elb* can take several forms) have been noted as far south as 10° 15′ N. in 23° E., and 10° 30′ N. in 15° E. In the Sourou depression, by which the upper Black Volta may once have reached the Niger, *mreyyé* persist to 12° 40′ N., while, in western Senegal, NE.–SW. longitudinal dunes, probably *alab*, can be distinguished south-east of Dakar, as far as the Saloum river in 14° N. These limits correspond with mean annual rainfall totals of 750 to 1000 millimetres and, like the ancient erg of Hausaland, they lie within the belt of dry woodland appearing as Zone 20 on the new Vegetation Map of Africa.

"It may be worth noting, apart from the controversy over the origin of fixed dunes, that vegetation patterns similar to those described from Somaliland and the Sudan are very common in this belt south of the Western Sahara, notably north and west of Sokoto; in the Niamey region, where they have been referred to as 'brousse tigrée;' and in latitude 14–15° N. between the meridians 5° and 7° W." A. T. GROVE

FROM THE *JOURNAL* A HUNDRED YEARS AGO

THE FOLLOWING extract is taken from "Notes of a voyage to New Guinea" by Alfred Russel Wallace, read to the Society on 27 June 1859 and published in the *Journal of the Royal Geographical Society*, Vol. 30 (1860), pp. 173–4.

"The inhabitants of Dorey live always on the coast, or more properly in the sea, as they always build their houses at or below low-water mark, raised on posts, and reached by a rough and tottering causeway from the beach. Of all houses I have yet met with, these are the most wretched. They are very low and long, and the roof is shaped like the bottom of a boat. Old mats, cocoa-nut leaves, broken boats, and bits of board, make a dwelling such as some shipwrecked sailors might hastily set up for a temporary night's shelter, but which it seems hardly credible that any people should contentedly live in. The natives of the interior do not differ perceptibly in physical character, but have a distinct language, and are called 'Arfaki' by the Doreyans. Their houses are very similar, but are raised 12 or 15 feet high, on a perfect forest of thin poles, a few of which are put diagonally, and prevent the whole from falling with the first wind. It is singular that these people know the use of diagonal struts, whereas the comparatively civilized Bugis and Macassar-men are quite ignorant of it, their houses being invariably inclined to one side by the prevalent winds, and only kept from falling by the posts being pretty firmly set in the ground, and the building connected with them framed strongly of bamboos. The Doreyans are fishers and traders, the Arfakis are agriculturists. The former catch turtle and tripang, which they sell for beads, knives, and cloth, and purchase of the Arfakis their rice and yams, plantains and breadfruits, and numbers of tame cockatoos and lories, which they sell again to the Ternate and Tidore traders. All these natives have the characters of the Papuan race very strongly marked;—the flat forehead, heavy brows, and large nose, with the apex bent downwards, are almost universal, as well as the harsh curly hair, which often forms an enormous stiff mop, and is then highly esteemed. It has, in fact, a very grand and imposing effect. The colour of the skin varies greatly. In general it is a dirty black, or sooty colour, but varies to a fine brown, which is often quite as light as that of the pure Malay races. Skin disease is very common, and in the children scrofulous diseases abound, which are seldom seen in adults; it is probable, therefore, that the former die from neglect. The men wear the ordinary strip of bark cloth, the women generally a Bugis sarong, or any piece of cloth or matting they can obtain. Tattooing is generally practised; slightly by the men, but much more extensively by the women, who usually have the whole chest covered with elegant tracery, following the curves of the bosom. The females, however, are, without exception, the least engaging specimens of the fair sex it has yet been my fortune to meet."

SECOND THOUGHTS ON THE NATURE OF GEOGRAPHY

PERSPECTIVE ON THE NATURE OF GEOGRAPHY. By RICHARD HARTSHORNE. *Chicago: Rand McNally, for the Association of American Geographers*, 1959; *London: John Murray*, 1960. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 202 pages.* $5 *and* 30*s*

THIS IMPORTANT little book is the first to appear of a new Monograph Series published by the Association of American Geographers. The new series and this monograph in particular will be widely welcomed, for Professor Hartshorne has established himself, since the publication of his 'Nature of geography' in 1939, as the most considerable writer in English on modern geographical methodology. His earlier book was in the first place a critical survey of European and American thought on this subject from the days of Kant, but in the course of this survey he arrived at certain conclusions, mainly coinciding with those arrived at by Hettner at the end of a prolonged discussion among German geographers. In the subsequent twenty years not only has there been a further output of methodological publications, but those conclusions have been digested and criticized; they have also suffered the common fate of being vulgarized and overworked as clichés. One is therefore glad to read this reassessment of the position by the same author which includes some survey of the recent literature (with a bibliography) but is more concerned to re-examine, restate, modify and extend the earlier conclusions about the nature of geography and the intellectual problems concerning it.

Ten basic problems are dealt with: (1) criticism and misunderstanding of the earlier definition of geography as the "science of areal differentiation," for which phrase Professor Hartshorne would now substitute "the variable character of the Earth;" (2) the meaning of the phrase "surface" of the Earth; (3) the integration (or synthesis) in geography of heterogeneous phenomena which also form the material of other sciences; (4) the measure of significance in geography, *i.e.* the basis of selection, from among innumerable Earth-phenomena, of those to be included in the geographical synthesis; (5) the distinction between natural and human factors; (6) the dualism of physical and human geography; (7) the place of time and historical explanation in geography; (8) the division into systematic (or topical) and regional geography; (9) the choice between the formulation of general laws and the description of individual cases; (10) the position of geography among the sciences.

In dealing with the problems 4 to 9 there is most opportunity for discussion of philosophical problems and it is at this part of the book, no doubt, that most criticism will be directed. This is not the place to attempt an examination of these problems, but it is permissible to draw attention to some of the more interesting changes of opinion since the earlier work.

In deciding which of the innumerable phenomena of the Earth's surface are to be chosen for inclusion in the integrating study of geography, Professor Hartshorne now comes out in favour of "concern to man" being a criterion to be added to Hettner's criterion of "relevance to the integration of other areal variations." His revised definition of geography now reads ". . . to describe and interpret the variable character from place to place of the Earth as the world of man" (p. 47).

Secondly, he criticizes and would like to drop the distinction between human and non-human (man and environment) because it is a relic of "environmentalism," *i.e.* the doctrine that the aim of geography was to study the relation of man to his environment. "Geography, in seeking to analyze the complexity of integrated phenomena in reality, is concerned to examine relationships among phenomena, of whatever kinds, which are found to be significant in the total integration" (p. 63). There is no reason, he suggests, to suppose that those between human and non-human phenomena will be always, or even usually, the most significant. But one might object that to throw away

environmentalism it is not necessary to abjure this distinction which almost all geographers find convenient. The proposal comes oddly from one who has just (p. 46) declared that significance in geography is measured in terms of significance to man.

Thirdly, "the traditional organization of geography by topics into two halves, 'physical' and 'human,' and the division of each half into sectors based on similarity of the dominant phenomena in each, is of relatively recent origin and has proven detrimental to the purpose of geography" (p. 79). "Specialization by topics will be most useful if based on associated phenomena, however heterogeneous, that are most commonly found in close relationship" (p. 80), as in the oceans, in towns, in agriculture. There is much to be said for the suggested divisions, but the traditional system has the practical advantage of recognizing the need for the practitioner in any branch of geography to acquire skill in the related systematic science.

Fourthly, in considering the problem of the place of the time-span in geography, Prof. Hartshorne deals with geomorphology in a way which will probably arouse some criticism in this country. He concludes that much of genetic geomorphology is unnecessary for geography since it is not "designed to explain the existing form of the land in terms of those characteristics most significant in interrelations with other elements of areal variation" (p. 91), and a plea is made for a "more geographic geomorphology." The argument leading to the conclusion that genetic geomorphology does not do this (p. 90) is thin, and the examples given (origin of coal, and comparison of the Central Massif and Bohemia) seem strangely inapt. Although these two massifs do indeed show the "fundamental contrast between concave and convex" there are nevertheless many similarities in both physical and human geography which are suggested by their similar origin.

"Geography is what geographers have made it" (p. 8), and we have no right to assume either that the reality they study will be symmetrical and harmonious or that they will have made a neatly logical and coherent body of knowledge. It is not surprising that there are difficulties about its limits, its internal relations and its place among other sciences. These difficulties are illuminated by Prof. Hartshorne in a most interesting and commendably short book. His language is not easy (partly indeed because of growing divergences of phraseology and usage between English and American), but it is to be hoped that the book will be widely read and discussed.

A. F. MARTIN

REVIEWS

GENERAL

ALLGEMEINE GEOGRAPHIE. Hrsg. von GUSTAV FOCHLER-HAUKE. (Das Fischer Lexikon.) *Frankfurt a. M.: Fischer Bücherei*, 1959. 6×4 *inches; 390 pages; maps and diagrams.* DM.3.30

This useful volume is rather a series of essays on geography and its branches than a strict lexicon. Rather strangely, there is no entry under "Geographie" or "Allgemeine Geographie," but this is covered by the entry "Logisches System der Geographie," with sub-sections on the geographical object, methods of study and unified systems of geography. This theoretical line is further developed in a lengthy article on "Landschaftskunde," and shorter entries under "Kulturlandschaftsgeographie," "Landschaftselemente," etc. These are illustrated by quotations from numerous authorities, mainly German. The fundamental issue appears to be the reconciliation of the aims of regional and general geography. Readers not familiar with the points at issue and the

German technical vocabulary will not find this easy reading, and will probably draw more profit from the articles on the branch subjects, agricultural geography, cartography, geography of settlement, physical geography and so forth. There are also useful entries on more concrete subjects, mountains, rivers, plains and peneplains, etc. There is a classified bibliography, mainly of German references.

G. R. CRONE

EUROPE

THE CONURBATIONS OF GREAT BRITAIN. By T. W. FREEMAN. *Manchester University Press*, 1959. 6×9 *inches;* 393 *pages; maps and tables.* 37*s* 6*d*

This must be the first attempt made by a geographer to condense a comprehensive survey of British cities into one volume, and in attempting this courageous task the author is to be congratulated. The subject matter covers a wide field and the bibliography is extensive; emphasis is given to the growth and the character of the administrative units of our cities. After a useful introductory chapter, outlining some of the urban features of British cities, six chapters are devoted to each of the six major conurbations of England. Perhaps an inadequate attempt is made to systematize the treatment of each conurbation apart from reference to the physical features of site and situation at the beginning of each chapter. This outline is then followed by three other chapters on what the author calls "the minor conurbations of England and Wales." Dr. C. P. Snodgrass has given a clear and useful account of the development of the Scottish conurbations in an additional chapter. The last chapter attempts to summarize some of the problems of the conurbation. It is Mr. Freeman's conclusion that "the main social problem of the future will be not in the town centres of the present, nor in many of the older and better outer residential areas, but in the suburbs built since 1919" (p. 355).

In view of the topical interest in our major cities, both with the planning problems of their future and the administration of their local authorities, there is much ammunition for debate in this book. But in a work dealing with such an amorphous subject there are bound to be omissions. Some readers may be surprised that in a book concerned with conurbations no reference is made to the principle of green belts, so dear to the planners. Whether the physical delineation of green belts is an adequate solution to the functional developments of our great cities needs consideration. Others may be disappointed that British urban growth is treated in a vacuum without any reference to the urban growth in comparable parts of Western Europe. Perhaps the main quarrel will be over Mr. Freeman's use of the term "conurbation." The statistical limit of 50,000 to 250,000 inhabitants is applied to "minor conurbations," and over this to "major conurbations" in England and Wales. Dr. Snodgrass, however, ranks Edinburgh (485,000 inhabitants) with the "lesser conurbations" in Scotland. She has described as conurbations only those cities which have fused two or more urban areas into one unit. Mr. Freeman, however, has applied the term "conurbation" to all single towns having "one thing in common: directly or indirectly they depend on industry in a way that the small town does not" (p. 210). Thus towns like Scunthorpe, Corby, Lincoln, Peterborough, Cambridge and others, are all treated as conurbations, making meaningless the concept implicit in this term. Surely it would be better to take the definition given by the Central Statistical Office in 1951: "an area of urban development where a number of separate towns have grown into each other and become linked by such factors as common industrial or business interest, or a common centre of shopping or education." The absorption of villages into the expanding town does not present the same administrative, social or planning problems as the fusion of two or more formerly distinct urban communities. It is perhaps not unfair to describe this work as the prolegomena of useful and interesting material; certainly it should be on the shelves of the planner, the local government official, the sociologist as well as the teacher of geography. The book is well written in a light and clear style, and illustrated with numerous maps.

J. M. HOUSTON

YORK: a survey, 1959. Edited by G. F. WILLMOT, J. M. BIGGINS and P. M. TILLOTT. *Published by the Local Executive Committee on the occasion of the meeting of the British Association in York, 1959.* $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 198 pages; maps and diagram.*

This latest addition to the series of regional handbooks published in connection with meetings of the British Association for the Advancement of Science conforms to the now traditional pattern of a physical and historical account of the larger region followed by a closer description of the city at its heart. It does, however, represent a new departure for it is lighter both in pounds and ounces and in the weight of scholarship deployed. This is not to suggest that the contributors are any less able, and it may be that this handbook is more likely to be read from cover to cover by the average member of the Association. It is to be hoped that what is certainly the geographer's loss will in this way be other members' gain. It contains more history than other recent volumes. This, of course, is to be expected, for history has a much greater part in the present life of York, and industry much less, than in other recent meeting places of the Association. The quality of the chapters contributed by different authors varies; the later ones on the social background of the modern city, though brief, seem particularly well done, but that on vegetation is little more than an annotated list of the wild plants which have become more or less rare since 1906, when the Association last met in York. There are a few slips, such as the use on page 60 of "selective weedkillers" when chemical weedkillers are meant, and a curious editorial practice in that the headings of some chapters differ (usually only in wording) from their form in the list of contents. The most unfortunate example is the second chapter, given in the list of contents as "Physiogeography" and headed on page 13 "Geography." It is neither. It is not an account of the relief, geomorphology or climate of the region, and the editors surely cannot have mistaken a part for the whole. After a brief general introduction the author plunges into an excellent short description of the settlement pattern, with particular reference to rural settlement and the conditions of its origin.

A. M. FERRAR

THE NARROW SEAS: a history of the English Channel. By REGINALD HARGREAVES. *London: Sidgwick and Jackson, 1959.* 9×6 *inches;* xviii+517 *pages; map.* 45*s*

THE ENGLISH CHANNEL: a history. By JAMES A. WILLIAMSON. *London: Collins, 1959.* $8\frac{1}{2} \times 6$ *inches;* 381 *pages; illustrations and maps.* 25*s*

The part the English Channel has played in 2000 years of English history makes an exciting and enthralling story which Mr. Hargreaves recounts pleasantly and authoritatively. Many persons will welcome this history of "the narrow seas that part the French and English" as a bedside book, probably too discursive for reading straight through but full of interesting matter at all periods. Naval history gets a full measure, and the author dedicates his book to the armed forces of Britain and America. He shows little sympathy with half-hearted fighters; after the Armada campaign we are told that "Elizabeth whimpered at having to foot the bill." King James is damned for liking peace and Cromwell, whom some suspect of liking war, fares little better. The book is full of sound comment mixed with quaint information and titbits. The bibliography is rather capricious: Hilaire Belloc is given 'An Elizabethan commentary,' but not 'The cruise of the *Nona*,' nor do we find Fielding's 'The journal of the voyage to Lisbon' or Thomas Pennant's 'From Dover to the Isle of Wight.' We are told: "For despite capricious weather, puzzling tides, and the incidence of pirates an expanding maritime trade plied briskly hither and thence across the Channel." But weather, pirates and tides are not headings in the index. There is no mention of Edmund Halley who solved those tides, nor of Greenvile Collins who made charts of Channel ports for Charles II. The little fishing boats of different types are not described. Which is only to remark that another man could write quite a different book with the same title without necessarily being any more interesting and entertaining.

And this is what has been done, with the same subject and a more direct title, by

a naval historian. It is not surprising that Dr. Williamson's is the better designed book and one planned too with many maps and other illustrations. The highlights of the history are pointed out and described in lively detail. Thus 1066 has a chapter to itself, as have the Cinque Ports. The rise of other interesting Channel ports is treated fully. This is a useful book of reference as well as a book which can be read through with pleasure. Once again the reviewer can complain that the history of the hydrographic survey of the English Channel has been ignored, but the little local fishing boats, each type developed according to varying conditions of service, have been described shortly but with loving care. Dr. Williamson writes as a professional historian who is also a yachtsman. In modern times his delight in yachting may lead him astray; yachtsmen could be found serving in all the armed forces of the Crown. The Royal Navy at H.M.S. *King Alfred* trained recruits to be naval officers, roughly whatever their background, and Coastal Forces was officered by these keen youngsters, many of whom can have had very little yachting experience in peacetime.

Very much English history has taken place in the Channel. Perhaps both our authors are a little short-sighted in one respect: the English Channel has two shores and the traffic across it has been as important as that passing through it. There is not enough in either book about the French shore, even treating it as of much less importance than the English side.

GEORGE NAISH

LA RÉGION PARISIENNE. By P. GEORGE and P. RANDET. LA RÉGION DU NORD ET DU NORD-EST. By R. NISTRI and C. PRÊCHEUR. (France de Demain, I, II.) *Paris: Presses Universitaires de France*, 1959. 9×6½ *inches;* 160 *pages; maps and illustrations*

These are the first two volumes in a series of eight which will cover the present regional economic geography of France, a product of general collaboration between academic geographers and civil servants. The title of the collection, 'France de demain,' gives a clue to the difficult task set by the editors. While French geography has long been renowned for its rich treasury of regional monographs, now has arrived the difficult problem of describing contemporary France regionally during a time of rapid technological and political change. The editors cite the oil discoveries in south-west France, the great development of electricity from high mountain valleys, the Common Market, and the European Coal and Steel Community as contributors to the increased pace of change in France's regional life. "We cannot, however, say that the speed will be the same in every region and that its impact will be the same in every part of the country." In other words, as the world shrinks, regional geography becomes more diverse; each small area has to make more specialized use of its resources and opportunities.

It is in this context of economic change that these books have been produced. They contain little physical geography, and even the basic historical geography is merely outlined. For example, in the first volume "The growth of Paris" occupies only seven pages. Such material is available elsewhere, and this series is best regarded as an appendix to established texts. Statistical information generally refers to 1954 and later. The two-tone diagrams are very clear, though some of the photographs seem to have been chosen for their aesthetic composition rather than for any particular quality of "place" that they represent. At the end the authors attempt to define the economic situation of each region. The overgrowth of Paris and decentralization within its region, and the less favourable economic prospects of the Nord compared with Lorraine, are forcefully brought out. Considering the difficulties of the task, and within the self-imposed limits, these first volumes succeed to a point where one looks forward to the remainder of the volumes in what will be a useful series.

JAMES BIRD

BEVÖLKERUNG UND WIRTSCHAFT IN SÜDTIROL. By ADOLF LEIDLMAIR. *Tiroler Wirtschaftsstudien*, 6 (1958), *Innsbruck.* 9×6½ *inches;* 296 *pages; maps and illustrations. Öst.-Sch.* 174

South Tyrol, the German-speaking part of the Tyrol south of the Brenner Pass,

which Austria had to cede to Italy after the first World War, has again and again been the cause of difficult relations between these two countries. Anybody, and in particular any geographer, anxious to learn about this country and its problems, is well advised to turn to this thorough and excellent study of South Tyrol by A. Leidlmair. Although topical, this is no hastily written political brochure, but a well-documented monograph based on extensive field-work and a detailed study of sources and literature.

The subject matter is discussed under four main headings: The physical and historical bases; the population; agriculture and forestry; the economic life (apart from agriculture and forestry). The first section (pp. 13–32) deals briefly with the origin of the name (Südtirol) and its boundaries, the physical bases, a division into sub-regions, and the settlement and political history up to 1956. The first of the nine very instructive folded maps (of which six are coloured) gives the boundaries and names of these sub-regions. The topic of the second section (pp. 33–116) is the crucial one of population. The increase in inhabitants from 205,000 in 1880 to 334,000 in 1951 was to a large extent due to immigration of Italians, as the increase of their number from 7000 in 1910 to 115,000 in 1953 clearly shows. This change in the ethnical composition is also well illustrated by a series of four coloured maps. The great increase in the Italian element—apart from anything else—makes it easy to understand the fears of the German-speaking South Tyrolese for their ethnical survival. The following section, on farming (pp. 121–229), again well illustrated with a coloured land use map and many sketch maps, gives a clear picture of this topic, including the physical and social conditions. Despite the economic difficulties which followed South Tyrol's separation from its traditional and natural markets north of the Brenner Pass, the Italian attempts to acquire farms have had little success, and 97 per cent. of all the privately owned land is still in indigenous hands. The last section (pp. 231–75), which deals with the rest of the economy, presents quite a different picture. The main industrial concentration is at Bozen, where altogether the factories employ over 6000—only 2·6 per cent. of them being South Tyrolese. For South Tyrol as a whole it is again characteristic that in enterprises with over 250 employees 90 per cent. of them are Italians. The available space does not permit more than mention of these major facts but they are surely enough to indicate the complexity of this problem of South Tyrol. When emotions become involved a painstaking investigation of all the facts is a particularly urgent duty. This duty has been discharged in an exemplary manner.

KARL A. SINNHUBER

PHYSISCHE GEOGRAPHIE DEUTSCHLANDS: eine Einführung mit Betonung der Geomorphologie. By FRITZ HAEFKE. *Berlin: Deutscher Verlag der Wissenschaften*, 1959. 9×6 *inches;* 357 *pages; maps, diagrams, illustrations.* DM.24.40

The vigour of German geography is exemplified by the publication within a period of six months of two physical geographies of Germany. Both volumes, that by Haefke here reviewed and that by Gellert (reviewed in the *Journal* for March) are much more than simple accounts of the landscape. They are in fact genetic descriptions, most stimulating compounds of stratigraphy, palaeo-geography and geomorphology. We must consider ourselves unfortunate that no similar volume is available for the British Isles. If asked by a favourite aunt which of these two volumes I should like as a gift, the choice would be difficult. The Haefke volume is in many ways the easier to use. Germany is dealt with regionally, whereas in the Gellert volume the treatment is rather more chronological and references to a given area are scattered. The Haefke volume is also the better produced. The sketch-maps are more pleasing and very useful. Of particular value are those of Hesse and Thuringia and of Saxony. There is an interesting use of a number of map excerpts to show representative areas, although this device is not so successful as it should be because only one scale, 1:200,000, is employed. On the other hand, although the Gellert volume is not so glossy, its treatment of the evolution of the land forms is fuller. The Haefke volume is probably of more interest to undergraduates and the general reader, the Gellert volume of more value to the post-graduate or research worker. Both books are

excellent, and both should be in all university libraries. Even for the non-German reader the sketches and tables will assist in gaining a knowledge of the land forms of Germany. My personal problem I shall solve by allowing my aunt to buy one for me, whilst I purchase the other myself. E. M. YATES

DIE CHEMISCHE INDUSTRIE DEUTSCHLANDS. By HORST SCHALL. *Nürnberger Wirtschafts- und Sozialgeographische Arbeiten.* **2** (1959). $9^{1}/_{2} \times 6^{1}/_{2}$ *inches; 156 pages; map*

Not so long ago, Germany dominated the world chemical industry, so it is not altogether surprising that the past looms large in this locational study. Indeed, the book opens rather alarmingly with an account of the industry in ancient Egypt, but progress through all centuries before the nineteenth is mercifully rapid. The chemical industry, so complex and so vast, shading off in all directions into other industries, presents to any economic geographer great problems of definition and treatment. Dr. Schall meets his difficulties by boldly dividing the industry into six main branches: heavy chemicals, chemicals from coal, plastics, fibres, pigments and a miscellaneous group. He describes carefully and clearly the development of each of these branches, showing how the location of the individual plants can be explained only by a knowledge of processes, materials and markets in the past, as well as today. Ideally, perhaps, all this excellent historical material might have been complemented by a rather more extended treatment of the industry's present economic geography. It would have been interesting to have had a little more information on the degree of localization of the various branches, on the strength of links with processes carried out by other plants within and outside the industry, on market areas and labour supply. Perhaps this is to expect too much; chemical firms rarely show much enthusiasm for disclosing the details of their current operations to the outside enquirer. Even so, we are left with a sound locational investigation, which will be essential reading for any student of the industrial geography of Germany and neighbouring countries. T. H. ELKINS

PARK: a geographical study of a Lewis crofting district. By J. B. CAIRD and members of the Geographical Field Group. *Nottingham: Department of Geography*, 1959. 10×8 *inches; 72 pages; maps.* 6*s* 6*d*

THE ALLEGHE AREA, ITALIAN DOLOMITES. A report on geographical field-work carried out during August 1958. *Nottingham: Department of Geography*, 1959. 10×8 *inches; 72 pages.* 6*s*

For many years Professor K. C. Edwards was the guiding spirit behind the Student Group of the Le Play Society. It would indeed be difficult to say how many geographers in positions of importance today gained their essential training in field-work in the course of home and continental visits which combined so successfully the camaraderie of those sharing like interests with enquiries organized by well-trained leaders. Professor Edwards and some of his old associates—Neville Scarfe, A. E. Moodie and Dr. Alice Garnett—are carrying their old work further afield through the Geographical Field Group. Several cyclostyled special Reports have now been issued by the Group. One is entitled "Park: a geographical study of a Lewis crofting district," and records the results of an intensive survey by a party of a dozen graduates and undergraduates led by Dr. J. B. Caird of the University of Glasgow, covering a peculiarly isolated district of eleven crofting townships and a deer forest. The "township" is the real basis of crofting organization, and the study covers 215 crofts (908 inhabitants) in great detail. The individually held croft land (usually the holdings have been consolidated) is separated from the common grazing on which each croft has a defined right of grazing, or "soum," by the township dyke, a stone or turf wall. The crofts are subsistence holdings and most crofts have milk from their own cow and sell a few sheep, but the range of crops is limited by physical conditions. Most crofters have a second occupation—as postman, road worker, quarryman or weaver, but nothing has replaced the once prosperous fishing. This is certainly a study which gets right down to fundamentals.

The other Report deals with geographical field-work carried out during August 1958 in the Alleghe area of the Italian Dolomites. The 26 participants under the leadership of Mr. F. A. Barnes worked as five groups, studying respectively geomorphology, vegetation, land use, settlement and industry. As no member spoke Italian the report relies on observation rather than interview, but full use has been made of published material and maps. There are careful sketch plans of the villages; the amount of new building suggests a region in transition as a result of the ubiquitous development of tourism.

Both Reports suggest that the Geographical Field Group deserves every encouragement.

L. DUDLEY STAMP

FIELD STUDIES: Vol. 1, No. 1. Edited by A. R. CLAPHAM and others. *London: Field Studies Council*, 1959. 8×6 *inches; 142 pages; maps and diagrams.* 5*s*

Field-work is now rightly an integral part of the training for a university degree in geography, geology, botany, zoology and others of the biological and earth sciences, and making arrangements for it has harassed university teachers for years. There is no doubt that the Field Centres organized by the Field Studies Council with their resident wardens, their collections of essential books and maps, their simple lab. and conference room facilities meet a long felt need. The spread of their work through a reasonable part of the year is not easy and there are obviously difficulties in their equipment, staffing and maintenance, but they are to be regarded as an absolutely essential unit in our system of higher education. Much intensive field-work remains to be done in Britain and it is not unlikely that the territory around the Field Centres will become classic ground as intensive studies by successive waves of students and teachers view with fresh eyes familiar scenes and familiar if still unsolved problems. It is therefore appropriate that the Field Studies Council should have ventured to issue the first modest number of a projected annual series dealing with studies carried out from their centres.

Included in the first number are eight contributions, well spread in interest and locality. Three deal with the Dale peninsula of Pembrokeshire (Dale Fort Field Centre): J. H. Barrett, the Warden, on birds, Miss B. J. Dresser on land use and farming, and J. Oliver on the climate. From Flatford Mill Field Centre, J. E. Morton and J. Machin write on Land Snails; from Juniper Hall, Mickleham, Miss V. J. Mercer discusses the geomorphology of the Tillingbourne. Pollen analysis of Malham Tarn and Tarn Moss is the subject of a contribution by M. E. and C. D. Pigott; from the Preston Montford Centre in Shropshire comes a full account of that interesting building stone, the Alderbury Breccia, from the top of the Carboniferous by I. D. Mercer, and an ecology study of the Shropshire Union Canal by Miss H. M. Twigg. The publication, modestly priced and very well produced, is to be made widely available through offprints at each Field Centre. This fine venture deserves the fullest support.

L. DUDLEY STAMP

DIE FLURFORMEN SLOWENIENS im Lichte der europäischen Flurforschung. By SVETOZAR ILEŠIČ. *Münchner Geographische Hefte*, **16**. *Regensburg: Michael Lassleben*, 1959. 9×6½ *inches; 132 pages; maps and diagrams*

In their foreword the editors of the *Münchner Geographische Hefte*, Professors Harkte and Louis, comment upon the slow circulation of knowledge across national frontiers, and their decision to publish a foreign paper which appears to them to be of general interest. One cannot but be grateful to them for they have made more widely available a work of importance. Ilešič first classifies the field systems of Slovenia: (1) open fields divided into blocks, (2) open fields divided into strips, (3) forms intermediate between (1) and (2) with either very regular blocks or a mixture of blocks and strips, (4) long strip fields, often running at right angles to the axis of a linear settlement, (5) solitary or separate fields. Of these five categories (1) to (4) are probably all open fields in our sense of the term. This is because we have generally been preoccupied with the distinction between the open field system and enclosures, rather than the

distinctions within the open field system itself. Such distinctions have been made elsewhere on the continent; Bloch in France distinguishes between "champs ouverts et allongés" or "open field classique" and "champs ouverts et irréguliers" or "open field en puzzle." Our difficulty is of course that the open field system has decayed but both categories (1) and (2), the forms distinguished by Bloch, do appear to have been present in this country, and some of the present field systems in the Vale of Pickering may be derived from (4). Ilešič then describes examples of these categories in various parts of Slovenia, discussing at the same time the problems of their origin. The examples are illustrated with a series of excellent maps. It is here that the wisdom of the editors is most clearly to be seen, for these problems are of general European interest, not least, because of their relationship with settlement pattern, in the British Isles.

This is a valuable work, intrinsically and because it summarizes for us many modern studies of field systems, some of which are relatively inaccessible, as they are written in Slavonic languages. It also focuses the need for a continued examination of the remnants of such field systems in our own country. Because of our magnificent series of MS. records we should be able to make a notable contribution to such studies of the rural landscape.

E. M. YATES

ASIA

WHERE CHINA MEETS RUSSIA: an analysis of Dr. Starlinger's theory. By JOHN E. TASHJEAN. *Central Asian Collectanea*, No. 2. *Washington D.C.*, 1959. 11 × 8½ *inches;* 67 *pages; bibliography.* $2.75

This study constitutes the second issue in Dr. Loewenthal's enterprising series. It analyses the theory developed in lectures and articles by Dr. Starlinger who, while undergoing imprisonment in the U.S.S.R. in 1947–54, had unique opportunities of discussing Soviet policy and Sino-Russian relations with purged Soviet officials and military officers. Starlinger believed that over-population will force the Chinese to expand into Soviet Asia and that this may lead to Sino-Soviet conflict. In addition to analysing and criticizing Starlinger's theory the study describes other conflicting theories and contains an extensive bibliography. The work is well documented and provides much food for thought particularly in the light of current events.

G. WHEELER

SOVIET MIDDLE EAST STUDIES: Parts I–VIII. By A. R. C. BOLTON. *London: Oxford University Press for the Royal Institute of International Affairs*, 1959. 10 × 8 *inches.* 3*s to* 5*s per part*

This series of mimeographed studies by a specialist in Russian who is also an Arabist takes the form of an analysis and a bibliography of selected Soviet studies on the Middle East; using "Middle East" in the Western sense in accordance with present-day usage, inadequate geographically though that may be. The Soviet use of the term "Near East" corresponds more closely (and justifiably) to our "Middle East," the latter in Soviet eyes being more or less confined to Persia and Afghanistan only. The series is by no means wholly comprehensive. Little space has been, or could be, devoted to the vast subject of Islamic studies, nor are archaeology or Arabic language studies covered. Even so the range is extraordinarily comprehensive and it includes geographical work, or work by Soviet geographers, as for example the work of the economist and geographer B. M. Dantsig on Iraq. By no means the whole output of Soviet orientalists is inspired solely by motives of pure research. A good deal is designed to reinforce State or Party policy. And it is perhaps to some extent for this reason that there has, since the last War, been an increasing emphasis on Asia, and most recently, on Africa. Nevertheless the standards established by such great orientalists as Bartold in the field of Islamic history and culture and of Krachkovskiy in modern Arabic literature have been maintained in many fields and Mr. Bolton has done a considerable service by bringing to notice the highlights of the vast mass

of Soviet writing on the Middle East, in geographical and other fields, in this admirably annotated, factual and objective group of studies. L. P. KIRWAN

DE LA PLAINE PAMPHYLIENNE AUX LACS PISIDIENS. By X. DE PLANHOL. *Paris: Bibliothèque Archéologique et Historique de l'Institut Français d'Archéologie d'Istanbul*, 1958. 6½ × 10 *inches;* 496 *pages; maps and plates*

There can be a welcome on many grounds to any detailed study within Asia Minor: for its size and status Turkey is still relatively unknown, and it is above all in many respects a transition zone between contrasting ways of life—Asiatic and European, Mediterranean and steppe, archaic and modern. M. de Planhol's study covers in very considerable detail the coast and interior around Antalya, which until very recently was isolated landward by poor communications and subject to severe endemic malaria; yet clearly from the abundance of historical remains once a region of considerable significance. The author traces the differing human responses to gradually changing historical circumstances within a highly varied geographical setting: there are still gradations from nomadism through transhumance to a sedentary life; and he reaches the conclusion that in this particular zone ways of life often show more of the influence of cultural and economic patterns than direct influence by the physical environment. Overall, the theme is one of slow expansion northwards by a cultivating peasantry into districts once given over to pastoralism. Much of interest may be derived from the volume: detailed regional description, based on first-hand, laborious acquaintance with peasant life in a relatively unregarded corner of Turkey; and the implications of the changes described. At a time when agricultural progress is much discussed within Turkey, and a Food and Agriculture Organization investigation calls for a "heroic programme of development" in order to provide for an expanding population, the appositeness of de Planhol's investigation needs little underlining. It stands as an example of what is now termed "applied geography"—a basic study starting from terrain, and from which others may draw more general conclusions, and a timely analysis of first causes. The reader may at times feel that greater succintness might have been achieved and that the maps could have been presented to better advantage. These, however, are minor matters—here is an approach of interest, value and appositeness. W. B. FISHER

THE CHANGING MAP OF ASIA. Edited by W. G. EAST and O. H. K. SPATE. 3rd Edition. *London: Methuen; New York: Dutton*, 1958. 8½ × 5½ *inches;* xi + 434 *pages; maps; bibliographies.* 36*s*

Everyone, be he geographer or student of world affairs, ought to buy this book; if he has never read it before, because it is so excellent, and, if he has seen earlier editions, for the extra reason that this new edition has been heavily revised and completely reset. The regions formerly covered by sections entitled "Far East" and "High Asia" are now regrouped in accordance with contemporary political realities, and dealt with under the headings "Communist China and Mongolia" (which includes Tibet) and "Far Eastern Regions of Asia" (Hong Kong, Formosa, Korea and Japan). Elsewhere revision is less heavy but, nevertheless, important; it takes care of such developments as recent phases in the Suez problem, the Five Year Plan of India, and political change in the former French Indo-China. B. H. FARMER

ÉTUDES SUR L'ÉTAT D'ISRAEL ET LE MOYEN ORIENT. By JEAN GOTTMANN. *Paris: Armand Colin*, 1959. 9½ × 6½ *inches;* 176 *pages; maps.* 950 *fr.*

Jean Gottmann, the French geographer, has collected a series of articles which have appeared in various French periodicals during the past 25 years on the subject of Palestine and the state of Israel and, in some measure, on the wider problems of the Middle East. The articles fall into three groups; one dealing with the progress of the Jewish colonization of Palestine in the years before 1940; a historical sketch of the relationship between the distribution of water resources and the existence of the traditional caravan routes and the rise and fall of Middle East civilizations; and a

third group discussing the political and economic development of the Israeli state since its creation in 1948. As M. Gottmann claims, the effect of the series is not marred by the fact that the articles have been written over so long a period. Some of what is said about pre-war events, for example the partition of Palestine projected by the British Government, is only of historical interest; but much of the treatment, for example, of Palestine's water and irrigation problems, is material to the situation in Israel today and the articles read well together as a connected whole.

M. Gottmann has visited Palestine often and has clearly been a close friend of the Israeli revolution. We are given a good picture of the struggles of the early Jewish pioneers to drain and irrigate the land; of the difficulties which confronted the young state in absorbing and assimilating a million immigrants from a great variety of countries in a decade; of the controlling importance of the federation of trade unions and the big Co-operatives in the economic and political life of the country; and of the successes and failures of Israeli economic policies. The country and its leaders have had to live dangerously in a military, a financial and a social sense, but the author is confident that the gains are solid and can be held. Through the army, the schools, the collective farms and the experience of work together a nation has been created and, although more than half of the immigrants have come from Asia and Africa, M. Gottmann thinks that the present predominance of European values and influences will last and this late venture in the expansion of Europe will be successful.

E. G. HANROTT

HISTORICAL RECORDS OF THE SURVEY OF INDIA. Vol. IV. 1830 to 1843: GEORGE EVEREST. Collected and compiled by Colonel R. H. Phillimore, C.I.E., D.S.O., late R.E. and Survey of India. *Dehra Dun*, 1958. 11½×8 *inches;* 493 *pages. Rs* 25 or 38*s* 6*d*

The fourth volume of Colonel Phillimore's great work on the Survey of India, derived from a critical examination of a vast number of unpublished reports, memoranda and letters, covers the years from 1830 to 1843 when George Everest was Surveyor General as well as Superintendent of the Great Trigonometrical Survey. He had fully equipped himself for the task ahead, and the first ten chapters of this volume are devoted to an admirable account of the work with which his name will ever be linked—the Great Arc of the Meridian in India and the "Gridiron" framework of principal triangulation, planned and begun by him and carried through to triumph by his successors. Chapters XI to XV describe the Revenue Surveys required by the Presidencies and Provinces, necessary for settlement and administration; Chapter XVI, geographical surveys and trans-frontier exploration, including that during the Afghan wars of 1838–42. The remaining eight chapters deal with the production of maps, with administration, and with personnel. As in the first three volumes of the series, there follow excellent biographical notes (some sixty pages) of the leading personalities who appear in the text. Among the better known may be mentioned Alexander Burnes (1805–41) and John Wood (1811–71); H. L. Thuillier (1813–1906) and T. Renny-Tailyour (1812–85), both with sons succeeding them in the Survey of India; Robert Shortrede (1801–68) of logarithmic fame; and Andrew Waugh (1810–78), who succeeded Everest as Surveyor General and built so wisely on the foundations laid down by him.

In a short review of this fascinating volume it is impossible to describe the wealth of detail and of new material, or to do more than draw attention to the methods and instruments used, the exactness of the scientific observations, the base measurements, and the emphasis laid on scrupulous accuracy. The personality and character of the far-seeing Everest himself dominate the book—planning and formulating the guiding principles, choosing (and sometimes discarding) his instruments (human and scientific) —working at high pressure all the time in the field and office, surmounting every obstacle, fanatically devoted to the completion of his self-imposed task. Nothing that could be foreseen was left to chance; nothing but the most accurate work possible satisfied him. Colonel Phillimore has collected on one page eight extracts under

the heading "The wisdom of George Everest." These reveal the principles on which he worked. Many of his letters and instructions are quoted in full. Though at times irascible and intolerant, he laid the foundations of scientific integrity in India and won the respect and devotion of his best men, among whom were his Indian assistants—the brilliant instrument-maker Saiyid Mir Mohsin Husain, and the Bengali computer Radhanath Sikdhar, both of whom became imbued with his own zeal.

Colonel Phillimore has now devoted twenty-five years since his retirement to the historical records of the Survey of India. No one could have been more meticulous in the search, interpretation and selection of documents. The volume is fully documented and illustrated by reproductions of contemporary maps and charts, plates showing types of the great observation towers and instruments, and portraits of Everest and others. The fifth volume, covering Andrew Waugh's Surveyor-Generalship, 1844–61, when the triangulation was extended on Everest's foundation over the whole of India and the Himalaya, is now in the press. KENNETH MASON

A PHILOSOPHY FOR N.E.F.A. By VERRIER ELWIN. With a foreword by the Prime Minister of India. *Shillong, India: North-east Frontier Agency*, 1959. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 296 pages; illustrations. Rs. 5*

Written before China began actively to press her claim to the submontane area south of the Tibetan frontier, this book does not set out in any detail the extent to which India has established effective administration over the 30,000 square miles of wild country. What is clear, however, is that she has in several places pushed right up to the frontier and has everywhere made advances far greater than the meagre funds available before independence made possible. It is to be regretted from the geographical standpoint that the only maps are decorative end-maps on a very small scale, which do, however, show the names of a few new administrative posts, and that the terrain is described only in the most general terms. But the book is essentially one of human, rather than physical, geography, in which is described a way of tribal life based on centuries old adaptation to a harsh environment and the problem is posed of what is going to happen now that one of the main features of that environment, namely isolation, is being rapidly removed by roads and landing-grounds.

The philosophy with which this problem is approached is that of Mr. Nehru himself, and a very wise philosophy it is. Briefly, he lays down that inevitable change must be controlled as far as possible by wise guidance; over-administration and the pouring in of outsiders with unfamiliar ways and ideas must be avoided, and all tribal rights in land and forests must be scrupulously respected. Almost everywhere in the world the policy towards tribal peoples has been one of drift, with results invariably harmful to them. Never before, it is probably true to say, has a programme been drawn up so comprehensive and so wisely conceived as that which India is now implementing on her north-east frontier. The difficulties are formidable, but are nowhere shirked or glossed over. Dr. Elwin, Adviser for Tribal Affairs, has written a book both interesting to read and deserving of serious study by governments and administrators, wherever in the world there is still time to save tribal peoples and equip them for the future. J. P. MILLS

PEOPLES OF OTHER LANDS. (Book 3 in the Junior Malayan Geographies series.) By G. E. D. LEWIS. *London, etc.: Longmans*, 1958. 9×6 *inches; 160 pages; maps, drawings and photographs*

This is one of a series of four books intended mainly for Primary Schools in Malaya. It takes its examples of people at work from various climatic regions. Its simplicity of wording and felicity of illustration are admirable, as are its frequent comparisons with Malaya (though what will a Malayan child make of the Yangtze delta as "the Holland of the East?") (p. 53). But is it too much to ask for a more imaginative approach to the problem of geography for children in under-developed countries? Is it not important to lead them gently to think, from an early age, of what a country really has to do to develop? And, in this connection, is it not a pity that this little

book overweights physical factors and that all its examples are of farmers and foresters, so that the child is not introduced to industrial societies and to consideration, however elementary, of what makes them develop? B. H. FARMER

THE PERSIAN GULF STATES. By SIR RUPERT HAY. *Washington, D.C.: The Middle East Institute*, 1959. 9×6 *inches;* 160 *pages; plates, endpaper maps.* $3.75

There are eleven Persian Gulf States—the oil-producing Shaikhdoms of Bahrain, Kuwait and Qatar, the seven small Trucial Shaikhdoms and the Sultanate of Muscat and Oman—and they were founded at different times by parties of tribesmen from Central Arabia. British authority in the area, which dates from the fifties of the nineteenth century, was acquired partly to protect Britain's communications with India and partly to control piracy and slave trading on the Trucial Coast. This careful study by Sir Rupert Hay, who was himself Political Resident at Bahrain from 1946 to 1955, makes it clear that this suzerainty is effective. It has survived to a remarkable extent the sudden influx of wealth following the discovery of oil (as recently as 1932), the consequent enlargement of American interests and the vicissitudes of British policy in the Middle East in the last few years. In all the States but Muscat Britain enjoys an exclusive position; she is responsible for the coordination of foreign relations and exercises control over the oil concessions. The Rulers receive advice on the improvement of their administrations and the development of resources; Muscat too accepts British advice but conducts its own foreign relations. The system is based on close personal contact between the Political Resident and the Political Agents and the Rulers and works smoothly. The Residency has its own courts which have jurisdiction over all foreigners in the Shaikhdoms. Since the form of government is everywhere patriarchal reform is slow and the families of the Rulers still exercise too much influence; in most of the States, however, there has been real progress in the quality of administration. So far the spread of prosperity has not brought with it an increase in anti-Western feeling; the people have more education and listen to the radio propaganda of Cairo and Baghdad, but although there is strong religious feeling there is little evidence of pan-Arab sympathies and it seems to be generally understood how much is owing to British protection and to British and American enterprise. However, Sir Rupert Hay expects that in the course of time pressure will be brought to bear on the Rulers to reform their administrations, and perhaps to make them more democratic. Much of the book consists of a factual account of such things as scenery, climate, flora and fauna, communications, amenities and Arab custom, and those working on the Gulf could scarcely have a clearer or more reliable guide.

E. G. HANROTT

TURKESTAN IN THE NINETEENTH CENTURY: a brief history of the Khanates of Bukhara, Kokand and Khiva. By MARY HOLDSWORTH. *London: Central Asian Research Centre in association with St. Antony's College (Oxford) Soviet Affairs Study Group*, 1959. 10×8 *inches;* 84 *pages; map.* 15*s*

This brief history has been carefully compiled and forms a valuable contribution to our knowledge of the areas described, which have been little written of in our language. The information is derived from Soviet sources, but has been carefully sifted and presented, and may be considered to be reliable. The contents are divided into three main headings: the Khanates, their cultural background, and Russia's entry, and it is the last-named which is the most valuable. Here is revealed the *Drang nach Osten* which has governed Russian policy for so long. In the nineteenth century commerce was the spur. Russia found it difficult to compete with western countries and so turned her attention to markets which were less competitive and where she could find buyers of consumer goods of perhaps rather lower grade than were expected in the West. Merchants went east. Trade fairs were instituted; missionaries were established (mostly in north-east Siberia), but religion and education brought up the rear. Today the thrust eastwards is no less energetic and pronounced.

H. ST. CLAIR SMALLWOOD

RIDING TO THE TIGRIS. By FREYA STARK. *London: John Murray*, 1959. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches*; 108 *pages; folding map, plates, wood engraving.* 21*s*

Turning aside from her dalliance with Alexander, Miss Stark has now written a book for which little historical excuse could fortunately be found. The result is a short, finely written account of a journey she took through the mountains of Turkish Kurdistan—a change of focus for which admirers of her early book, 'The Valleys of the Assassins,' will be grateful. The first half of 'Riding to the Tigris' deals with the better known area between Van and Hakkiari, but the most valuable part of the book is the second half which covers her journey, largely on horseback, from Beiteshebab to Jizre on the Tigris. The mountainous landscape, in all its arid, anatomical beauty, is marvellously invoked—no traveller can describe it better. The people she met on her journey, particularly the local administrators, are keenly and usually sympathetically drawn, but one would be glad of more information about the lives of the women, a field of study for which a woman travelling in a Moslem country has an advantage over a man. It must be admitted that readers seeking new information about the Kurds will find little of it here. The book brings out the power of the *Vali* (governor) of the Turkish province and the dependence of the traveller upon his goodwill. The Iraq frontier was particularly sensitive at the time of Miss Stark's visit, and Turkish officials, though usually tolerant and kind, seem to have kept a sharp eye upon her. Temporary arrest is an occupational hazard the traveller must expect in the wilder parts of the Near East, but such incidents are none the less annoying. The confiscation of two rolls of film near the end of her journey shook Miss Stark rather badly. Fortunately she managed to salvage other rolls, and from these are drawn the exquisite landscape photographs that illustrate her account of this little-known corner of Turkey—a country which she describes as the most splendid, varied and interesting in the world. 'Riding to the Tigris' is an enjoyable, wise and beautifully written book, and can only add to that stream of optimistic travellers, scientists and archaeologists who yearly seek permission to travel in eastern Turkey.

P. H. DAVIS

TRAVEL IN ASIA

TRAGIC DESTINY (*Faber & Faber*, 1959, 18*s*) is the intimate story of an independent missionary, George N. Paterson, who has become one of the few up-to-date authorities on Tibetan affairs. He states unequivocally that Communist China's policy is to "liberate" the whole of Tibet, but only as part of their longer-term policy of including Nepal, Sikkim and Bhutan and finally India (which may be taken to include Pakistan) in this "liberation." He feels himself directed by God in the task of revealing to the world this Asiatic hegemony which drives Communist China to any lengths. The author entered the country from western China and became the friend of the most prominent Tibetans of the Kham and Amdo provinces of eastern Tibet. On behalf of these sections of the Tibetan peoples he made a journey from Tibet to India to represent their case to the Indian Government, a task of which he would appear to have acquitted himself well. This is a very important book and should be read by all those who wish to acquire an understanding of this highly complicated situation. Appendices 1 and 2 should be read with care.

BACK TO BOKHARA (*Jonathan Cape*, 1959, 18*s*) is no less readable than Fitzroy Maclean's previous 'Eastern approaches' and 'A person from England.' Tashkent, Samarkand, Bokhara, are names which are redolent of romance and one reads the author's description of them today without disillusionment. It is true that Maclean travelled as a tourist de luxe which had its drawbacks as well as advantages. The illustrations are first class and the two photographs of the Church of St. Basil (now a museum) and Moscow University are in such violent contrast that it is difficult to believe that the same race could have produced such widely differing edifices.

WINDOW ON NEPAL (*Robert Hale*, 1959, 18*s*), without pretending to offer an exhaustive study of Nepal, the author, Tibor Sekelj, succeeds in opening wide a

window through which the reader may inspect and appreciate this little-known country. The translation is adequately done and the illustrations help considerably in the presentation of attractive places and people. The account of King Mahendra's democratic journey throughout the "jungly" parts of the country is an interesting one. We are not told much about the stout-hearted Gurkha soldier who has fought in so many battles and campaigns for the British Raj, but one is left with a realization of the valued contribution the Sherpas, personified particularly by Tensing Norgay, have made to the world's knowledge of the last range of the highest Himalaya.

PRINCES OF THE BLACK BONE (*John Murray*, 1959, 21*s*): Mr. Peter Goullart, while engaged on Co-operative work on the Chinese–Tibetan border, paints an interesting picture of the little-known Lolas. The world at large is interested in affairs on these borders and the author has contributed to the scanty knowledge possessed by the very few.

NEPAL BIBLIOGRAPHY published by the American–Nepal Education Foundation of Eugen Aregon in 1959: Professor Hugh B. Wood's work on this volume is of considerable value, and for eastern knowledge libraries it is a "must."

H. ST. CLAIR SMALLWOOD

AFRICA

STUDIEN ZUM VOR- UND FRÜHGESCHICHTLICHEN LANDSCHAFTSWANDEL DER SAHARA: III. DIE NATURLANDSCHAFT ÄGYPTENS WÄHREND DER VORGESCHICHTE UND DER DYNASTISCHEN ZEIT. By K. W. BUTZER. *Wiesbaden: Franz Steiner*, 1959. For the Akademie der Wissenschaften und der Literatur in Mainz. 10×7 *inches;* 80 *pages, illustr.* DM.8.80

Dr. Butzer has ransacked all the relevant literature and reinforced his book-learning by personal examination of the prehistoric and early dynastic sites in Egypt. The good work of the late Professor Louis Keimer on the ancient fauna and flora has helped him, and for historic changes in sea level he relies upon a recent paper by D. Hafemann. Some new points are raised. The author considers that the Neolithic Nile Valley was far from being an uninhabitable chain of papyrus swamps and he queries the usually accepted rate of deposition of Nile silt. This has been taken as about 9 to 10 cm. per century; but Dr. Butzer gives reason to believe that this rate may have been considerably exceeded in the past when the discharge of the Blue Nile was much greater than it is today (*see* A. J. Arkell, 'Early Khartoum'). He puts the beginning of the deposition at the outset of the Neolithic period to about 5000 B.C. About the same time the local climate improved into a "Neolithic Subpluvial" when both deserts east and west of the Nile were inhabited by artists who drew elephant, rhinoceros and giraffe on the rocks. These larger animals disappeared about First Dynasty times (possibly because the zones of summer rain from the south and winter rain from the north no longer overlapped near the tropic). The antelopes, better adapted to following the rains, survived and were hunted until the start of Dynasty VI, *c.* 2350 B.C., when rainfall ceased altogether. That is, the author suggests that from then until 500 B.C. the climate was even drier than it is today. (If so, why did the New Empire architects take so much trouble to prevent damage by rain? See Clarke and Engelbach, 'Ancient Egyptian Masonry,' pp. 154–61.) After Dynasty VI, the Pharaohs no longer hunted in the open desert but shot game preserved in parks. Later still they contented themselves with watching their huntsmen delivering the *coup de grâce*. By XIXth Dynasty days death had become very gloomy and the cult of the dead banished the "sport of kings" from the walls of their tombs. This long, detailed monograph provides a valuable backcloth to the dramatic scenes of Egyptian history which so many Royal authors have handed down to posterity. (There is a slip: the section at Hieraconpolis, where three metres of Nile mud were deposited before the reign of Pepi II and two later, was measured by Quibell and Green and not by your reviewer. My fault!)

G. W. MURRAY

FORSCHUNGEN IN DER ZENTRALEN SAHARA: I. Klimageomorphologie. By WOLFGANG MECKELEIN. *Braunschweig: G. Westermann*, 1959. $9\frac{1}{2} \times 5\frac{1}{2}$ *inches; 181 pages; plates and diagrams*

This report of a field study in the Fezzan area of southern Libya (1954–5) is well illustrated and organized. Distinction is made between *Halbwüste* (peripheral), *Vollwüste* (normal?) and *Extremwüste* (core) deserts. The desert in the classical sense is characterized by forms such as hammada, serir (both eluvial and alluvial!), erg, wadi, sebkha, etc. The erg, considered predominantly fossil, and most of the wadis, are seen as attributable to periods of moister climate. In the hyper-arid desert cores, on the other hand, serir and *Staubwüste* (dust desert) with polygonal soils (saline anhydration is the indicated agency) are characteristic. The loose consolidation of the upper soil layers by salts reduces deflation to a minimum, thus preserving more distinctly all traces of water action. No fossil forms are recognized here. All in all, the regional treatment is good and the topical discussions of desert land forms and their genesis are stimulating. Of further value are microclimatic observations of both air and soils by N. Richter, and analyses of some 200 selected soil samples by K. H. Sindowski.

The book raises problems, too. Why, for example, should the erg indicate a moister climate? A major part of the material is derived from deflation of the hammada and serir of the *Vollwüste*, where desert pavement is still being formed elsewhere in the Sahara. Is not the rubefaction of the great Edeyens an indication of soil formation during stabilization under moister conditions following arid phases of dune formation? The consideration of the literature on the geomorphology of other parts of the north-eastern quadrant of the Sahara and the treatment of the role of Cenozoic climatic evolution in the development of desert land forms seemed inadequate to the writer. Nevertheless, Meckelein's study is perhaps the most valuable analysis of the *Klimageomorphologie* of arid zones published in the past decade or more.

K. W. BUTZER

KARIBA: the struggle with the river god. By FRANK CLEMENTS. *London: Methuen*, 1959. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 223 pages; illustrations. 16s*

Frank Clements' 'Kariba,' let it be said at once, is quite first class, and a reviewer can do little more than to urge anyone who has not read it to do so at once. It is the story of the building of the Kariba Dam across the Zambezi River between Northern and Southern Rhodesia, from its first conception in 1912 to the completion of the great wall, 1900 feet long and 420 feet high, which has created an artificial lake 175 miles long and covering 2200 square miles of country.

From time to time during the building years, the world's press carried articles on the physical difficulties of the project, the awarding of the contracts, the opposition of the native peoples living in the path of the lake, the damage caused by Zambezi floods, and the activities of "Operation Noah." Mr Clements has brought all these together, pruned them of sentimentality, sensationalism, and downright lies and produced a unique account of a great venture.

L. M. FORBES

SUN AND SHADOW AT ASWAN. By HERBERT ADDISON. *London: Chapman and Hall*, 1959. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 166 pages; maps, plates and figures. 18s*

The aim of this book, by a former professor of civil engineering at Cairo University who has spent a lifetime in Egypt, was to celebrate the sixtieth anniversary of the building, by British engineers, of the Aswan Dam and in it the author, in an agreeable narrative blended of nostalgic memories and personal anecdote, tells the story of the Dam and its successive heightenings in 1912 and 1934. Yet a third heightening was proposed in 1945. But this, soon afterwards, was overshadowed by the new and quite revolutionary proposal to build the High Dam, the Sadd el Aali, of which so much has since been heard. To those like the writer who have seen the existing dam in its various later phases, Professor Addison's earlier chapters will have a special appeal.

But the later chapters about President Nasser's High Dam scheme will be of the greatest general interest.

For months, the world's press has been full of news of the High Dam, but how many know anything of the history of the idea, or of what is exactly proposed? How many know, for example, that a Greek engineer, Adrian Daninos, was the originator of the scheme; that the High Dam will not be a dam at all in the ordinary sense, but a gigantic bank or dyke, built not of granite but of natural sand, gravel and boulders; a solid impenetrable barrier putting an end to all river transit (there is no railway or made road) between Egypt and Sudan? There will be no sluice-ways or navigation locks. The Nile waters on their way northwards will be diverted through tunnels driven through the rocks on both banks. By comparison with this great construction, the present Dam will be a puny affair. One hundred and thirty million tons of water (as against six) will be stored in the new reservoir and this water will rise two hundred feet above the highest of previously recorded levels. Towns and villages and ancient temples will disappear for ever not only in Egyptian Nubia but in the northernmost Sudan. Indeed, new homes will have to be found for over fifty thousand Sudanese who have lived for generations on the banks of the Nile.

No less an authority than Dr. Hurst expressed the opinion in 1955 that "there is no alternative to the Sadd el Aali proposals . . . to provide, in the least possible time, extra water for the further development of Egypt and Sudan." Certainly, such a vast inland sea, absorbing all variations in the flow of the Nile south of Aswan, seems likely to provide all the water required for years to come, for Sudan, Ethiopia, Uganda and Egypt, without need for discussion or dispute. And Egypt would obtain the power for industry she so badly needs from the two great hydro-electric stations to be built between the new Dam and the old. But there are problems too; of enormous wastage since more than a tenth of the volume of water entering the reservoir will be lost by evaporation; and, more seriously, of erosion. The new stored water, Professor Addison points out, will not be "natural" but partially clarified water and its erosional effects on the existing river bed, especially in the vicinity of the resistant floors of the barrages farther north, could be disastrous. In such comments Professor Addison brings his expert knowledge to bear on a project which, when it comes to pass, will change the geography of a substantial slice of Africa. L. P. KIRWAN

MIGRANT LABOUR FROM SOKOTO PROVINCE, NORTHERN NIGERIA. By R. MANSELL PROTHERO. *Kaduna: Government Printer, Northern Region of Nigeria*, 1959. $8\frac{1}{4} \times 6\frac{1}{4}$ *inches;* 46 *pages;* 9 *maps in folder.* 5*s*

Mr. Prothero has added to his earlier studies of labour migration in north-western Nigeria with this report.[1] He is to be congratulated on the care which he has taken in using material from censuses and from the 1952/53 survey of labour migration in Sokoto Province for, as he states, in the latter case the checkpoints "could be by-passed without difficulty" and "there was no way of avoiding double or even treble counting of some of the migrants." Inevitably the conclusions drawn by the demographer in West Africa must be severely limited by the nature of the material, and the author's comments point to the need for more effective surveys which, for labour migration at least, should be based on international cooperation. It is a pity that the author received no galley or page proofs for the quality of the typography fails to do justice to his work. W. B. MORGAN

LE PAYS D'UVIRA. By G. WEIS. *Brussels: Académies Royales des Sciences Coloniales*, 1959. $9\frac{1}{2} \times 6$ *inches;* 308 *pages; maps, diagrams, plates*

This book describes an area west of Lake Tanganyika, of less than 500 sq. miles; the physical environment is given one-third of the text, the people two-thirds. This

[1] Earlier studies have appeared in: International Geographical Union, Report of a Symposium held at Makerere College, September 1955, 1956, pp. 49–54; *Africa*, **27** (1957), pp. 251–61; *Corona* (May 1957) pp. 169–72.

small chieftaincy includes four distinct physical regions—the lake-shore piedmont, the lower slopes and the upper slopes of the rift valley side, and the Itombwe plateau to the west. Of these the plateau appears the most suitable for human activity; the slopes seem the least propitious, particularly the lower slopes which are subject to heavy downpours; the piedmont, flatter and open to the lake, has the disadvantages of higher temperatures and a tendency to aridity. The greater part of the plateau is uninhabited. The upper slopes are likewise largely deserted, and hold only 8 per cent. of the total population. The lower slopes contain 36 per cent. of the total population, with an average density of 163 per sq. mile. The piedmont, 3 per cent. of the total area, carries 42 per cent. of the total population with an average density of 725 per sq. mile. Demographic vitality, however, is least on the piedmont—the one area touched by European influence—and greatest on the plateau. The child/woman ratio, for example, is only 1·46 on the piedmont, 1·82 to 2·16 on the slopes and 2·25 on the plateau.

The contradiction between environmental optima and population maxima is explicable in terms of history and custom. One result is that the slopes, least favoured by nature, are the food-producing region of Uvira, and M. Weis expresses justifiable concern over the future effects of increasing population and decreasing yield. Particularly is this disturbing in view of man's power as an agent of erosion, illustrated by the gullying of footpaths and by the effects of farming methods, most damaging on the steep slopes. The work is concluded with a series of recommendations for the planned economy of the district and for administrative changes without which this could not succeed. This is an admirable study, well documented, with supporting statistics whenever available, of an unmapped terrain largely untouched by Western influence, and is written in an easy style with a commendable sense of humour.

J. C. PUGH

NO ROOM IN THE ARK. By ALAN MOOREHEAD. *London: Hamish Hamilton*, 1959. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 227 *pages, plates.* 21*s*

This is a record of three journeys made in Africa by the author during the past few years, and contains graphic descriptions not only of the animals and birds but also of the African people he met. His first visit was by the old flying-boat service which went by easy stages up the Nile to Lake Victoria and then by the lakes along the Great Rift Valley until eventually Durban in South Africa was reached. Most of the stops were at out-of-the-way places and there were fascinating glimpses of authentic African scenes. His recent journey to Johannesburg was a very different affair, for today the great majority of wild game has disappeared from South Africa except in the National Parks, and the Africans, for the most part, have changed their mode of life. The author visited the Kruger Park and Hluhluwe reserve in South Africa and then travelled gradually northwards until he reached the sources of the Nile in Uganda and the Belgian Congo, visiting the various game parks en route.

Another trip was made in the company of a well-known white hunter from Nairobi to the extreme south-western corner of Kenya and Tanganyika, where the Serengeti Plains are the scene of the great January migration of animals towards Lake Victoria before the rains begin; they then travelled north to Lake Rudolf and camped at the edge of the Marsabit reserve. Another trip was made through the Karamoja district along the north-eastern corner of Uganda, then to the Turkana country on the western shores of Lake Rudolf; and finally there is a journey down the Nile from its source in Lake Victoria to Khartoum, through two hundred and fifty miles of the great swamp of the Sudd. The author has succeeded in giving a wonderful picture of the country and its inhabitants. Those who have visited any of the parts he describes will recapture the atmosphere, and armchair travellers will find delightful glimpses of some of the last great natural spectacles in an over-populated world. EDWARD HINDLE

DAVID LIVINGSTONE: FAMILY LETTERS. Edited with an introduction by I. SCHAPERA. *London: Chatto and Windus*, 1959. *Two volumes:* $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 266 *and* 320 *pages.* 60*s*

We have here a rich store of material from which to enlarge our understanding of the

character of David Livingstone and the two volumes of letters will reward long and serious study. At a first reading, Livingstone appears as a far more human being than in any of his formal published books. Though he assumes an insouciant air in his letters home, he is clearly hungry for news of his family circle and indignant that he does not receive it. He bullies and cajoles them into emigrating to America and clearly regards Scotland as a good place to be out of. On the other hand there are many nostalgic references to the beauties of the Clyde Valley where his childhood was spent. In his relations with fellow-missionaries in South Africa, he is forceful and forthright to the point of rudeness. He is impatient of and even uncharitable with the weaker among his brethren and he must have been more than something of an *enfant terrible* in mission circles. This was nothing, however, to his resistance to Boer pressure and he is less than polite to them, their clothes, language, customs and manners. With his wife he is tender if unromantic, but very much the Victorian dominant male in the lack of consideration he shows for her in her frequent pregnancies. Their first-born is an event, the rest incidentals in his restless trekking.

But the most interesting aspect of the letters is the way in which Livingstone's frustration with the dull routine of a mission station grows. He is a devout man, an earnest Christian, of course, but not a churchman. He sees no special virtue in spending long years training up a congregation in the rites of any church: he wishes his missionary activity to be extensive—to preach the gospel and to move on, sowing the seed broadcast but not tarrying to cultivate the field. From this, it is an easy step—especially after the Boers burnt his house and possessions—to press on into the "regions beyond" and to achieve the great trans-continental journeys. It might have been that he then became a mere explorer, but on his journeys the full horrors of slavery were borne in on him and his future career was formulated—to crusade against the desecration of "God's image in ebony." R. MILLER

NORTH AND SOUTH AMERICA

THE CANADIAN NORTHWEST: its potentialities. Edited by FRANK H. UNDERHILL. *Toronto: University Press; London: Oxford University Press*, 1959. 9×6 *inches; 104 pages; map*

This slim volume brings together six essays (and a brief introduction) which were papers delivered to the Annual Meeting of the Royal Society of Canada held at Edmonton—gateway to the Northwest—in 1958. Each author is left to interpret "Northwest" as he sees fit and the area considered varies from 700,000 square miles to double that total. There does, however, seem to be general agreement that the absence of rail communication is a major unifying factor. The emphasis throughout is on inaccessibility: where the cost of transporting a plumber to a town is equal to the value of three weeks' work. Though Canadians are, it is said, inherently sun-worshippers and hate the long winters, it is stressed that climatic difficulties are no greater than in the prairies. The engineer, R. F. Legget, in a rather slight review, recalls the vast wartime expenditure on roads and other works now abandoned; the geologists, A. H. Lang and R. J. W. Douglas, emphasize that it is world demand rather than Canadian resources which will determine the importance of mineral development of deposits known and unknown. The two most substantial contributions are those by Professor W. C. Wonders (Professor of Geography at Edmonton) entitled "Assessment by a geographer" and by D. S. Rawson on "Biological potentialities." At present the actual knowlege of these vast lands is woefully inadequate and the research programme far too limited. Both Rawson and D. B. Turner on "The resources' future" point out the urgent need for more knowledge before transportation is so improved as to render the Northwest vulnerable to serious exploitation. With one inadequate map, and no index, this volume serves as a reminder of the many problems rather than a serious assessment. Included in a pocket, however, is a copy of the

Third Edition of the official map of north-western Canada on the scale of 50 miles to the inch overprinted with details of transportation facilities, 1958.

L. DUDLEY STAMP

THREE CENTURIES AND THE ISLAND: a historical geography of settlement and agriculture in Prince Edward Island, Canada. By ANDREW HILL CLARK. *Toronto University Press; London: Oxford University Press*, 1959. 9½×6½ *inches;* 288 *pages; maps.* 80s

It may seem surprising that the smallest and least diversified Canadian province, with barely 100,000 inhabitants, should be the subject of one of the first detailed studies of the historical geography of any part of Canada. As one step in Professor Clark's long-run work on the settlement overseas of people from the British Isles, ". . . the study of three centuries of change in this unknown island has much to contribute to an understanding of geographies of settlement and agriculture in north-eastern North America." This is a microcosm in which the impact of more widely significant social and geographic forces can be disentangled. Moreover, in his "minute scrutiny" of this small and comparatively uniform area, Professor Clark has been able to carry out an experiment in analysis by means of comparison of series of detailed maps. He used over 1200 in all; of these, 155 are embodied in the book. They show progressively such patterns as those of settlement, land use, crop yields, livestock and farm values. They reveal significant relationships between these various patterns. They also reveal "the changing patterns" which, "studied as dynamic, rather than static, entities," make possible the better understanding achieved by interpretation of the processes at work which are constantly changing them.

Some interesting conclusions emerge concerning, for example, the close association of the pattern of land use with the origins of settlers: Highland Scots cling stubbornly to growing oats and Acadians to raising horses. Momentum is shown to be an important factor in changes in the density of settlement, and analysis of the differences between pioneer and retrograde areas gives a clearer understanding of changing patterns of "high farming" and "poor farming." Other themes include the effects of large-scale absentee ownership, the introduction of potatoes and the impact of prairie wheat.

IRENE M. SPRY

PEDIMENTS IN SOUTHEASTERN ARIZONA. By YI-FU TUAN. University of California Publications in Geography, Vol. 13. *Berkeley and Los Angeles: University of California Press*, 1959. 10×6½ *inches;* 140 *pages; maps, plates*

One of the more intriguing problems of the arid cycle is concerned with the origin of the bare planed rock surfaces or *pediments* found in desert areas. A number of ingenious theoretical ideas have been put forward to account for the evolution of this feature, but the arguments have so far been largely based on visual impressions and little information has been available regarding the actual size, areal extent, distribution and lithological characteristics of the morphological elements. Yi-fu Tuan, on the basis of field-work carried out between 1953 and 1955, has now provided geomorphologists with the first detailed account of some fifteen major pediments on south-eastern Arizona. All are mapped, described and analysed in detail, and then considered collectively in relation to their adjacent catchment basins and mountain areas, their geological structures and lithological composition, and their gradients, areas and form. On the basis of this objective approach the relative merits of the various hypotheses on pediment formation are then tested.

The study reveals a paucity of evidence in support of lateral planation as a significant process in the formation of pediments and leads Yi-fu Tuan to reject the theories of W. D. Johnson. The area, however, exhibits signs of a current regradation of the pediments together with indications of recent exhumation. The author concludes that the detailed observations support a theory of exhumation that is closely akin to A. C. Lawson's deductive analysis of the development of the sub-alluvial bench. Degradational processes in an area of basin and range topography are considered to

produce two types of rock surface, the mountain front and the sub-alluvial bench. The former diminishes and the latter increases in size with increasing age, when the visible elements of the landscape consist of small mountain residuals surrounded by broad alluvial aprons. The sequence of development from a high mountain front with a narrow sub-alluvial bench to a low mountain front with a broad sub-alluvial bench requires tectonic stability. If at some stage the slope of the piedmont is increased by rejuvenation of the axial stream or by tectonic movement, degradation of the alluvial apron will exhume the sub-alluvial bench and reveal it as a visible element of the landscape. The amount exposed will clearly depend on the stage reached and the magnitude of the change. The monograph presents lucidly a great deal of detailed field observation on the pediment problem; it is at present unique in this respect and it will clearly be eagerly studied by all concerned with this fascinating aspect of geomorphology.

W. G. V. BALCHIN

NATIVE PEOPLES OF SOUTH AMERICA. By JULIAN H. STEWARD and LOUIS C. FARON. *New York and London: McGraw-Hill*, 1959. 9×6 *inches*; xi+481 *pages; maps, illustrations.* 66*s*

It is now more than ten years since the appearance of the 'Handbook of South American Indians,'[1] the six-volume study, under the editorship of the senior author of the present work, which sought to "summarize the facts of aboriginal ethnology" for America from the Antilles and Honduras south to Cape Horn. In 'Native peoples of South America' the authors have compressed the material of the 'Handbook' into one tenth as many pages, incorporating much new material, and have achieved an interpretative synthesis of considerable interest.

After a brief objective examination of the problems associated with the origin, development and interrelations of New World cultures, the theme is developed that "there is considerable correspondence in South America between environment and cultural types." The authors' approach to the theme of man's relation to his environment is permissive rather than deterministic. Whilst the importance of diffusion is acknowledged, stress is placed on the relations between the great irrigation civilizations and the coastal desert and the high, moist, mountain massif of the Central Andes, between the independent villages of slash-and-burn farmers and the rain-forests of the humid tropics, and between the chiefdoms or petty states and the broken highlands of the circum-Caribbean region. Cultural development in the deserts and scrub steppes of Northern and Central Chile was limited to small-scale irrigation societies. To the south, western and eastern Patagonia, being too wet and too dry, respectively, for agriculture, were inhabited only by nomadic hunters and gatherers. The link between environment and sociocultural type lay in the potential of the former for yielding a surplus of food. This was necessary for the support of non-food-producing classes of military, religious, political and craft specialists. Thus, the Inca were able to conquer and exact tribute from highland communities a thousand miles from Cuzco, whilst tropical forest villages a few score miles away yielded no surplus and remained independent.

The greater part of the study is concerned with a fuller consideration of each of the five major types of society in terms of: economy and its relation to environment; technology and manufactures; social, political and religious structures; and regional variations. All the descriptions refer to the period of initial contact with Europeans. In addition the phases of prehistoric development in the Central Andes are treated at length. An era of Hunters, Gatherers and Fishers was succeeded by a period of Incipient Farming. Theocratic states later evolved, only to be absorbed by a succession of Empires—the Tiahuanaco, Chimú and finally the Inca. In view of the interesting similarities between these phases and the types of society already discussed, it is all the more to be regretted that the field of the 'Handbook' has not been extended

[1] *Bulletin of the Bureau of American Ethnology*, No. 143, 1946–50, Washington: Smithsonian Institute.

in this comparative study to include the other New World high civilizations, the Maya and Aztec Empires of Meso-America.

The book concludes with a brief discussion of the post-Conquest fates of the aboriginal societies, as do the individual sections, and an outline of the different forms of acculturation. J. COLIN CROSSLEY

INCAS AND OTHER MEN. By GEORGE WOODCOCK. *London: Faber*, 1959. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 268 pages; map and plates.* 25*s*

The author, a writer and Professor of English at the University of British Columbia, visited Peru during the closing weeks of the Odría regime in 1956. His journeys took him to the prehistoric city of Chanchan and the irrigated oases of the desert coast, to the backward agricultural valley of the Callejón de Huaylas, dominated by the peaks of the Cordillera Blanca, to the squalid mining and bustling market towns of the Central Highlands, down to the tropical pioneer fringe at Tingo María (which reminded him of Canadian frontier towns), and finally to the Inca heartland around Cuzco and Lake Titicaca, where the vestiges of a past civilization make that invigorating highland a region of unequalled fascination. 'Incas and other men' tells the story of his extensive travels or, rather, it depicts with accuracy the places he visited and describes with sympathy and understanding the people encountered; for the author has, refreshingly enough, no wish to magnify the limited hazards and inconveniences of travel by public transport in the Andes into the ordeals of an Odyssey. Leaving the stage to the People and the Land Professor Woodcock sets their present story against a background of archaeology, history and politics and thereby gives his descriptions a useful perspective. Only occasionally does his careful eye fail him. The Infiernillo bridge carrying the Central Railway across the Rimac gorge lies 150 not 1500 feet above the river (p. 38); the War of the Pacific was fought over nitrates not phosphates (p. 216); and the fertility of Peru's empty Amazonian half is in all probability largely mythical (p. 106). Two dozen fine monochrome photographs illustrate the book, but the neatness and clarity of the single map are marred by inaccuracies in the representation of relief. J. COLIN CROSSLEY

AUSTRALASIA

BIOGEOGRAPHY AND ECOLOGY IN AUSTRALIA. Edited by A. KEAST, R. L. CROCKER and C. S. CHRISTIAN. (Monographiae Biologicae, Vol. VIII.) *The Hague: W. Junk*, 1959. $9\frac{1}{2} \times 6\frac{1}{8}$ *inches; 640 pages; maps, figures, plates.* 25*s*

This is a general account comprising thirty-seven sections, each written by an expert on the particular subject under consideration. The first section, on the uniqueness of Australia in biology, by the late Professor F. S. Bodenheimer, is a stimulating introduction to the immense problems facing this continent, especially the great ecological problem of establishing the potentialities of under-developed areas.

"The Australian environment," by Allen Keast, contains an excellent summary of the physiography of the continent and emphasizes some of the difficulties resulting from the unreliability of the rainfall, for nowhere is there such a huge area of pastoral land with such an erratic rainfall as in the pastoral country of Australia. A series of diagrams illustrate the climatic zones and other aspects of this environment. The section on human ecology in Australia, by Griffith Taylor, starts with a strong plea for classifying geography with the sciences rather than with the humanities. It is noted that the effect of environment on bacteria, beetles or baboons is accepted as a valuable contribution to science, but the effect on Man of such environments as topography, climate, soil, etc., is called geography, and is commonly regarded as one of the humanities.

Apart from the first four sections most of the book deals with the ecology of animals and plants. The zoogeography and origin and development of the Australian fauna and flora is dealt with in a number of sections and still offers many fascinating problems, for some components seem to have come from the north and others from

the south. The book is also of special interest in its presentation of a series of modern scientific achievements: the biological control of the Prickly Pear, which made immense tracts of Queensland available from useless land into good pastures; the discovery of the wild stage of ornithosis, better known as psittacosis in parrots; the partial history of sheep-blowflies of Australia, affecting the sheep industry; the rabbit pest, its control by myxomatosis, and the future outlook; Merino sheep and its pasture problems; agricultural application in various botanical studies. These and many others are only some of the examples of the way in which biological problems affecting the present and future of man in Australia have been successfully tackled.

EDWARD HINDLE

A VISION OF STEEL: the life of G. D. Delprat, C.B.E. By PAQUITA MAWSON. *Melbourne: F. W. Cheshire*, 1958. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 270 pages; plates, endpaper maps.* 42*s*

Lady Mawson, the daughter of one famous Australian and the widow of another, has written in this book the life history of her father, that remarkable Franco-Dutchman who, after an energetic and adventurous life as an engineer in Holland, Scotland, Spain, Norway, Mexico and Canada, came to Australia in 1898 as General Manager of the Broken Hill Proprietary Company. He transformed it from a moderate-size silver, lead and zinc mining business into one of the greatest iron and steel companies in the world, producing steel as cheaply as anywhere in spite of the notorious Australian labour costs, aggravated by a hopelessly unrealistic arbitration system. (His criticism of that system in 1922, quoted on page 217, has been echoed in the press in 1960.)

Throughout his later life Delprat kept careful diaries; and by quoting from these and from his letters Lady Mawson has produced a well-documented story. It is rather heavy going at times, for the diaries are the purely factual records kept by an extrovert man of action, with hardly any reference to thoughts or emotions, and Lady Mawson is not versed in the art of compression and selection, so that there are too many entries of this sort: "June 17, Board Meeting in the Office. Lunched with them, dined with them, also Horwood, Bristowe, Lindsay and Eley." Further, in her anxiety to do justice to the role of her mother, another remarkable French-Dutch character, and to show the family background, Lady Mawson has crowded her canvas with other figures, and following the procession of names is sometimes rather a breathless business. The persevering reader, however, will be rewarded by an unusually intimate view of Australian conditions at the turn of the century and later. The sketch-maps at the beginning and end of the book are clear and useful.

L. COLLIER

GEOLOGY OF NEW ZEALAND. By FERDINAND VON HOCHSTETTER. Edited and translated by C. A. Fleming from the original German of 'Geologie von Neu-Seeland,' 1864. *Wellington, N.Z.: Government Printer*, 1959. $10 \times 6\frac{1}{2}$ *inches;* xxiii+320 *pages; maps, lithographs and engravings; appendix*

In December 1858 an Austrian frigate, *Novara*, visited New Zealand in the course of a circumnavigation of exploration and scientific discovery. The young geologist, Hochstetter, was invited by the Governor, Sir George Grey, to examine primarily the volcanic region of the North Island, as well as the Auckland (Waikato) coalfields. Although only nine months altogether in the country, Hochstetter accomplished a remarkable amount of work in both the North and the South Islands. A fortunate circumstance was the recent arrival in the country of a young German geologist, Julius Haast, who joined forces with Hochstetter in his extensive field-work. Much attention was given to the volcanic and thermal districts of the North Island, including the nature and distribution of hot springs and geysers. Hochstetter supplied a splendidly detailed description of the famous White and Pink Terraces of Rotomahana. which were subsequently tragically destroyed in the great Tarawera eruption of 1886, The goldfields of Coromandel and Nelson were examined, and near Nelson he investigated the copper and chrome ore of Dun Mountain, associated with the

well-known "dunite" rock-type, which he first named. He left the examination of the structure of the Southern Alps to his friend, Haast; but his name is immortalized in such famous features as the cascading Hochstetter Glacier and Hochstetter Dome, near Mount Cook, whilst in Novara Peak, above the Tasman Glacier, is commemorated his Austrian ship. Professor von Hochstetter, as he was later, returned to the University of Vienna, and there produced in 1864 his monumental work entitled 'Geologie von Neu-Seeland.' It is this important treatise, at the centenary of his visit to New Zealand, that has now been given an outstanding translation by Doctor C. A. Fleming, the eminent Senior Palaeontologist of the New Zealand Geological Survey. As this Survey's Director, Mr. R. W. Willett, declares in his foreword, "Dr. Fleming's translation has so feelingly preserved the sense and excitement of Hochstetter's narrative" that it is a fitting tribute to the memory of the "father of New Zealand geology." But this fine volume is not only of geological significance: it constitutes also an important contribution to New Zealand history, ethnology and descriptive geography. Reproduction in colour of Hochstetter's original maps, and many lithographs and engravings are a valuable addition. The text has references to the original pagination, and useful footnotes are added by Dr. Fleming. N. E. ODELL

THIS ISLAND'S MINE. By WILFRED FOWLER. *London: Constable*, 1959. 8½×5½ *inches;* 240 *pages; illustrations.* 21*s*

Despite the battles for Guadalcanal, the Solomon Islands and those who live there remain neglected. These sombre islands are not the South Seas paradise of fancy; nor have Melanesians, emergent from a meagre Neolithic existence and often repellent traditions, the immediate appeal of ocean-voyaging Polynesians. Yet the archipelago is full of interest, with many forms of life peculiar to it and largely doomed to extinction whenever our civilization makes its belated impact. The Solomon Islanders merit our respectful attention, not least for their loyalty during the Japanese occupation; while the small colonial service which earned their trust still carries out its unconsidered and ill-rewarded duties in solitude and discomfort. 'This island's mine' describes how a young District Officer, fresh from England, was left to administer the hundred-mile-long island of Ysabel with the help of his native crew and police force.

The reader who cannot detect, from clues in the narrative, that it tells of the Solomons before the war, may well feel aggrieved to be informed of the fact in a postscript. The British withdrawal, occupation, American influence, increasing air travel and the decline of the copra and shell trades have left their mark on the Solomons. The "Marching Rule" movement for independence has come and gone, the islanders have a part in their government, the capital has been moved from picturesque Tulagi to dusty Honiara on the mainland of Guadalcanal, to which the aloof Western Pacific High Commission has come from distant Fiji. Yet the atmosphere of this book, and the detail of life in the districts, remains true. The reader wanting a general account and a bibliography of the Solomons will find them in this *Journal* (**123**, (1957), pp. 298–317) in the text of a lecture delivered to the Society on 25 March 1957 by Mr. John Grover. I. C. J. GALBRAITH

POLAR

PILOT OF ARCTIC CANADA. CANADIAN HYDROGRAPHIC SERVICE, SURVEYS AND MAPPING BRANCH, DEPARTMENT OF MINES AND TECHNICAL SURVEYS, OTTAWA. *Ottawa: The Queen's Printer and Controller of Stationery*, 1959. 10×6½ *inches;* xxiv+183 *pages; gazetteer and maps.* $5.00

This Volume deals generally with the Canadian Arctic; Volumes II and III will cover the actual navigation in the eastern and western Arctic regions respectively. It appears to be firmly based upon the Arctic Pilot Volume III issued by the (British) Hydrographic Office; many passages are quoted *verbatim*, but there is much additional information. The British Pilot is printed on matt paper, with glossy illustrations;

the reverse practice is adopted in the more attractive Canadian publication, but light reflections on the shiny pages make it less easy to read.

Chapter I deals solidly with the physiography of the Arctic, in rather more detail than would be appreciated by the average mariner. Descriptions of the inhabitants and life of the area are followed by an account of the numerous and frequently disastrous expeditions that, starting with Frobisher in 1576, gradually penetrated the frozen fastnesses. It is curious to learn that Commander M'Clure, who, over a century after it was offered, won the Admiralty prize of £20,000 for the discovery of the famed North-west Passage, did so by approaching the Passage from the west, completing the final link by crossing the ice of Viscount Melville Sound from south to north on foot.

The experience of the Canadian Government season after season with its several icebreakers must make the chapter on "Ice" the last word on the subject. The section designed to help vessels operating in ice is obviously the distillation of vast and probably bitter experience. Detection of ice by radar is referred to, and the book states that "In the Arctic, radar is more than just an aid; it is by far the most valuable instrument for navigation." There is, as yet, no advice on underwater navigation in the Arctic Ocean.

Disappointingly, there are no illustrations of ice formations as in the British Pilot, nor is there a list of references; there are, however, several small-scale maps which neatly summarize the chief features of the area. To read this book with understanding requires the assistance of maps or charts on not too small a scale; Admiralty Charts 2118, 2177 and 863 should be adequate. L. S. LEPAGE

CIRCUMPOLAR ARCTIC FLORA. By NICHOLAS POLUNIN. *Oxford: Clarendon Press*, 1959. $9\frac{1}{4} \times 6\frac{1}{4}$ *inches;* 514 *pages; map and line drawings.* 126*s*

This book is the first Flora of the whole Arctic region. It contains keyed descriptions and line drawings of 892 plant species. The author's concept of species is somewhat conservative and he gives no account of microspecies, subspecies or varieties. The names of critical species are followed by *s.l.* (*sensu latissimo* or *sensu lato*) or by agg. (aggregate). Although the author claims that this is a "non-critical" Flora more than half the names are followed by *s.l.* or agg. A plant establishing itself in the Arctic is faced with many severe hazards all of which must be overcome if it is to be successful. If one admits that most Arctic plants have evolved or are evolving from temperate ones it is not surprising there are species complexes. This book is of little use to the professional botanist, even the references to species aggregates and synonyms are insufficient. Keeping within the claims of the author it has adequate descriptions and keys, and most of the line drawings are very good. This book can certainly be recommended as a guide to wild flowers of the Arctic. CHRISTOPHER D. K. COOK

THE ARCTIC YEAR. By PETER FREUCHEN AND FINN SALOMENSEN. *London: Jonathan Cape*, 1959. $8\frac{1}{2} \times 5\frac{3}{4}$ *inches*; 440 *pages; maps and illustrations.* 28*s*

This is a book which combines the researches of the modern biologist with the more casual style of the traditional naturalist and makes fascinating reading for any one interested in life in the Far North. Peter Freuchen's long years of experience in the Arctic have given him an expert knowledge of the lives of the Eskimos and the way in which they manage to survive under extremely difficult conditions. Dr. Salomensen, a distinguished Danish ornithologist and naturalist, is an outstanding authority on Arctic ecology and the adjustments between men and animals, birds and plants in the Arctic world. The seasonal panorama within the Arctic cycle is painted by tracing how man, beasts and plants exist under changing conditions from January, through spring, summer and autumn, and on into the new long winter of an Arctic December. The difficulty of defining the boundary of the polar regions is overcome by restricting the zone to areas that do not reach a mean temperature of 50° F in the warmest month. This also more or less agrees with the tree line, which is not a straight line as its position is affected by several factors in addition to climate. Curiously enough,

the winter temperature is practically of no importance in tree growth, for when dormant trees are influenced very little by cold, and dense forests of larch occur at Werchoyanok in Siberia where the lowest mean temperature in the world for any winter month (−58·2° F) has been recorded. This remarkable book presents a very different picture of the Arctic from that usually accepted, and the authors note that those who have been in the Arctic always long to go back. The reason for this spell may be that in the absence of trees, houses, noise, and with often no other human being for scores of miles, you feel alone in the world, alone with your thoughts, and the mind experiences a touch of eternity. EDWARD HINDLE

AMERICA IN THE ANTARCTIC TO 1840. By PHILIP MITTERLING. *Urbana: University of Illinois Press*, 1959. 9×5¹₂ *inches;* 202 *pages.* $5

This is an original contribution to the writing of Antarctic history, in fact, the first book covering a special aspect of a particular period of time. The author deals fairly briefly with the progress of exploration to 1800. He writes in more detail of the American sealing voyages of the late eighteenth and early nineteenth centuries, and at length about the United States Exploring Expedition 1838–42, commander Charles Wilkes. In covering these forty years, Mitterling has two knotty problems to unravel, about which a considerable amount of polemic has been written. These are the questions of who was the first to sight the Antarctic mainland: the American sealer Nathaniel Palmer, the British naval master Edward Bransfield, or the Russian naval captain Thaddeus Bellingshausen; secondly, the validity of Charles Wilkes's claims to discovery, and the worth of his detractors' assertions in the light of present geographical knowledge. In elucidating these problems, and indeed throughout the book, the author has made a thorough and detailed study of a vast amount of published and unpublished literature, as is shown in his essay on sources at the end. Four chapters are devoted to the intellectual, social and political background to the United States Exploring Expedition, and one is left with a feeling of surprise that the expedition ever sailed, and of admiration for what it managed to accomplish. Both here and elsewhere one is grateful for a calm appraisal of the issues and personalities involved, and for an assessment of the American contribution to Antarctic discovery. A useful index completes the book. A minor slip appears on p. 64: the late W. S. Bruce was never knighted. ANN SAVOURS

POLAR TRAVEL

Mr. James Fisher, co-author of 'Shackleton' (London 1957), once told me that while he was recording the voices of surviving members of the *Endurance* expedition, at least one of them so relived his experiences that he wept in the telling. One appreciates this very well after reading Alfred Lansing's ENDURANCE (*Hodder and Stoughton*, 1959, 21*s*). We too live through the hardships, perils and dangers that beset Shackleton and his men from the crushing of their ship in the ice of the Weddell Sea to their rescue at Elephant Island. Especially vivid is the account of Shackleton's incredible voyage in the *James Caird*, a twenty-two foot whale-boat, from Elephant Island to South Georgia. Mr. Lansing is to be congratulated on his use of sources, both manuscript and verbal, and on his good writing. An index would have been helpful.

When Dr. Berket-Smith's THE ESKIMOS first appeared in 1936, Professor Rudmose-Brown wrote: "Not only is he a scholar conversant with every aspect of the subject, but he shows a happy faculty for lucid exploitation combined with a power of concentration that results in a valuable work covering all the ground within the compass of some two hundred pages." A new edition of the book has now been published (*Methuen*, 1959, 32*s* 6*d*) with modifications and additions reflecting the changes that twenty years have produced both in the knowledge of the past history of the people and in their social development. The book remains the classic work on the Eskimo and one of the most readable of its kind.

Sally Carrighar's MOONLIGHT AT MIDDAY (*Michael Joseph*, 1959, 25*s*) is a portrait of what she terms the "residents' North"—Alaska, as known to those who live there.

As a resident herself of more than five years' standing, she is able to speak with authority. Miss Carrighar writes well and sympathetically when describing her eight months' stay in the Eskimo village of Unalakleet. This first part of the book is mainly pleasantly readable, personal narrative and reflection. In the second part, the author finds more difficulty in describing life in the towns and does not always succeed in weaving her experience and knowledge into a well connected pattern. Her comments on social conditions will interest those concerned with the future of America's 49th State.

L. M. FORBES AND ANN SAVOURS

PHYSICAL AND BIOLOGICAL GEOGRAPHY

BEACHES AND COASTS. By CUCHLAINE A. M. KING. *London: Edwin Arnold*, 1959. 9×6 *inches;* 403 *pages; diagrams.* 65*s*

Although a number of morphological books on the coast have appeared in recent years most have been descriptive and qualitative. In 'Beaches and coasts,' however, Dr. C. A. M. King offers a new and unique approach with a mathematical and quantitative treatment. Emphasis is also placed upon the processes which shape the coast. Waves, the wind and the tide all receive a full and exhaustive analysis, the effect of varying aspects of each being considered systematically. Considerable use is also made of recent data derived from model experiments in the Hydraulic Research Laboratory at Wallingford and the physical laboratory of the Department of Geography at Cambridge. Methods of research, both in the field and in the laboratory, are enumerated; and the book also includes a survey of classification systems and the development of coastal types. Extensive lists of appropriate references in a great variety of journals and languages are given at the end of each chapter. Although the new methods of laboratory analysis and field investigation have produced some notable advances, much yet remains to be done in the realm of coastal research and here the book will undoubtedly be of great value.

Civil engineers concerned with coastal defence problems will also find Dr. King's book of great interest. In recent years there has been a growing realization of the value of a geomorphological approach to many civil engineering problems. The geomorphologist is largely concerned with the evolution of the present day landscape which mainly results from weathering and erosive processes; landscape is envisaged as evolving by definitive stages according to the processes involved. Human interference will therefore either retard or accelerate Nature's intentions. An understanding of these intentions and the processes at work in any particular environment is clearly a first requisite if coastal engineering works are to be successful. Here, perhaps more acutely than anywhere else, the civil engineer finds himself either in conflict with, or endeavouring to harness, the forces of Nature. In the past the geomorphologist has derived a great deal of help and information from the civil engineer so far as coastal matters have been concerned. With the appearance of Dr. King's book, however, this debt has undoubtedly now become a credit balance.

W. G. V. BALCHIN

LAND-FORMS AND LIFE. By C. C. CARTER, revised by MARGARET O. WALTER. *London: Christophers*, 1959. $7^{1}/_{2} \times 5^{1}/_{2}$ *inches;* 296 *pages; maps and diagrams.* 12*s* 6*d*

Those who know the original Carter will expect rapid surveys which need supplementing by geological and morphological maps. This has never been either a book of map-interpretation or a physical text, regrettably influential though its physical ideas have been. Dr. Walter, noting that Carter's geomorphology is out-of-date, has nevertheless retained outdated and confused material. It would be interesting to learn the justification for statements that a shoreline becomes mature when it first attains a smooth plan (p. 254), that granite is a weak rock (p. 32), and that misfit streams owe their condition to capture (p. 74). *Ridge* connotes a tabular cuesta (pp. 126 ff.); backslopes are labelled *Escarpments* (Fig. 25); *finger lakes* is used as a generic term equivalent to *ribbon lakes* (p. 154); and the deplorable term *Pennine Karst* is retained (p. 112). Obvious mistakes include *lateral corrosion* (p. 35), *raised*

bench (p. 231), and the assertion that Lincolnshire Limestone is less well-jointed than Carboniferous Limestone.

The necessary distinction between stage of river-development and stage of landscape-development is not made. Point bars and the outer bends of free meanders are confused with the spurs and scars of incised meanders (p. 53). Carter's misuse of meanders to assess stage remains, if only by implication; recent work on flood-plains and profiles has had no effect. The term *smaller*, applied to meanders (p. 59), is meaningless unless either amplitude or wavelength be specified. Until field observations are made, it is not permissible to say that the Ribble is just carrying its load, is graded, and has reached maturity (p. 54). If grade is a balance between erosion and deposition (p. 35), how can graded rivers on a mature landscape reduce that landscape to senility? The mistaken association of deltas with low tidal ranges recurs (p. 63); like Carter, Dr. Walter ignores the data of tide-tables.

One sympathizes with Dr. Walter in her task of refurbishing a book which has outlasted its purpose. Geography has moved on since Carter's day. Literary style, however, would seem not to have done so. This revision includes misused comparatives, misused demonstrative adjectives, unrelated participles, and as many as six coy sets of unnecessary quotation-marks to a page. G. H. DURY

GEOGRAPHISCHE FORSCHUNGEN. Festschrift zum 60. Geburtstag von Hans Kinzl. Edited by HERBERT PASCHINGER. *Innsbruck: Universitätsverlag Wagner*, 1958. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches; 325 pages; maps, illustrations. Öst.-Sch.* 198

Hans Kinzl, now rector of Innsbruck University, has been professor of geography there since 1935. His interests have centred on recent glacial fluctuations, and many of the papers of this Festschrift, gathered together to celebrate his sixtieth birthday, reflect the same theme. There are indeed six papers concerned with either glacial fluctuations (in the Tyrol, New Zealand and the Taunus) or with periglacial weathering. Also related to a glacial theme is a paper by H. Paschinger on the gravels of the Inn valley. This applies morphometric analysis techniques, as developed by Cailleux, to the gravels and thus distinguishes the Inn terraces from the ice-margin terraces. It is a paper of regional interest, but at the same time a very useful example of methodology. A further four papers deal with climatology. They are: types of rainfall of part of South Germany; the agricultural meteorology of the South Tyrol; temperature anomalies; and an interesting attempt by H. Louis to reassess the importance of latitudinal temperature zones. In the latter the temperate zone is divided into a subtropical zone and a mid-latitude zone, and zonal boundaries depart from the mathematically determined boundaries (*e.g.* the tropics) to the extent of showing the influence of factors such as ocean currents. The remaining papers, thirteen in all, cover a wide variety of topics, including: Japanese population problems; vineyards in the South Tyrol and Alsace; the southern boundary of lands known to classical geographers. In this miscellaneous group is a useful comparative regional study of Steiermark and Silesia, although its value to the English reader is reduced by a lack of illustrative material. E. M. YATES

PHYSISCHE-GEOGRAPHISCHE STUDIEN. Festschrift zur Vollendung des 60. Lebensjahres von Hans Spreitzer. Edited by KONRAD WICHE. *Vienna: Mitteilungen der Geographischen Gesellschaft* **99**, parts 2 and 3 (1957), pp. 109–244; **100**, parts 1 and 2 (1958), pp. 5–143. $9\frac{1}{2} \times 6\frac{1}{2}$ *inches; 279 pages; maps, diagrams., illustrations.*

This volume, published in honour of the 60th birthday of Professor Spreitzer, is a reprint of papers from two editions of the journal of the Geographical Society of Vienna. Professor Spreitzer, president of the society, holds the Chair of Physical Geography in Vienna, a chair previously held by many famous geomorphologists such as A. Penck, G. Brückner, F. Machatschek and J. Sölch. Spreitzer's own studies have included a development of W. Penck's views on "Piedmonttreppen," the glaciology of Russia, and the Würm glaciation of the Austrian Alps. The papers here assembled, contributed by friends and colleagues, show a similar wide range of

interest. A number are directly concerned with the morphology of Austria. There is for example a paper by A. Winckler v. Hermaden on the surfaces of the Eastern Alps, which contains a denudation chronology for those mountains. An interesting paper by Ludwig Weinberger on the Ibmer Moss in western Austria develops a number of glacial themes that are of more than regional interest. Two papers show evidence of the present tendency to mensuration techniques. One is a paper by V. Paschinger on the relative coarseness of drainage nets; the other, by G. Hohl, on the profile of a large pit at Gaustadt in Franconia, uses particle size, colour and heavy mineral analysis to separate and date the formations there exposed. As is often the case with such German language publications, a number of the other papers deal with arid landscapes. The whole is well produced with clear diagrams and maps, and excellent photographs.

E. M. YATES

ZOOGEOGRAPHY. Edited by CARL L. HUBBS. *Washington D.C.: Amer. Assoc. Adv. Sci.* Publication 51. 1958. $9^{1}/_{8} \times 6$ *inches;* x+509 *pages; illustr.* $12

Zoogeography provided much of the evidence which led Darwin and Wallace to propose the concept of organic evolution, yet after the publications of these two great zoogeographers the subject received comparatively little attention until recent years. The present book, published as one of the symposium volumes of the American Association for the Advancement of Science, comprises the papers given at two symposia, the first held at Stanford University in August 1957, on "The origins and affinities of the land and freshwater fauna of western North America," and the second in December 1957, at Indianapolis, on "Geographic distribution of contemporary organisms." The first section includes fourteen contributions on different aspects of the subject and starts with a chapter on the "Evolution of modern surface features of western North America" by Philip B. King. Then follows an account of "Climate since the late Cretaceous" by H. D. MacGinitie, in which the author considers that the fundamental cause of world climatic changes has its origin in small fluctuations in the amount and kind of solar radiation. The role of physiology in the distribution of terrestrial vertebrates is discussed by George A. Bartholomew, in which it is also shown that the distribution of many marine organisms and terrestrial invertebrates depend on physiological tolerances. When phylogenetic series of vertebrates are considered the relationship becomes more obscure and, in the case of the higher vertebrates, distribution seems to depend largely on behavioural and ecological factors. Other special aspects of geographical distribution are dealt with in succeeding chapters, each of which ends with a bibliography giving the more important references.

The second part is occupied mainly by three general articles, the "Pleistocene ecology and biogeography of North America" by Paul S. Martin; the "Palaearctic element in the New World Avifauna" by Kenneth C. Parkes; and "Distributional patterns of vertebrates in the southern United States in relation to past and present environments" by W. Frank Blair. The editor, Carl L. Hubbs, in the final chapter on general conclusions discusses the various contributions, from which it is evident that the fauna of the Pacific Coast is of unusual interest and presents many fascinating problems.

EDWARD HINDLE

LEHRBUCH DER ALLGEMEINEN GEOGRAPHIE: ALLGEMEINE VEGETATIONSGEOGRAPHIE. By JOSEPH SCHMITHÜSEN. *Berlin: Walter de Gruyter,* 1959. $9^{1}/_{2} \times 7$ *inches; maps, illustrations, text-figures.* DM.28

Professor Schmithüsen's book is one volume of a larger work 'Lehrbuch der allgemeinen Geographie' and the only one which deals exclusively with the plant-life on this planet. Within the compass of 231 pages of text the author ranges over an immense number of topics which have any bearing on the plant-cover of the earth.

The book is divided into three parts, the first of which deals with the taxa which make up the vegetative cover, the area occupied by them, and by extension, the floristic regions of the earth. This involves consideration of the life form of plants and their adaptation to the various climates and soils, to conditions of light and heat

and so forth. The second part discusses the units of vegetation as part of the landscape. Here an attempt is made to classify units of vegetation controlled by climate, ecological factors or a combination of both. The role of Man as a controlling factor comes in for dishonourable mention, as indeed he deserves. As destroyers of vegetation, Man and his domestic animals have no equal. The third part considers the spatial arrangement and organization of vegetational units on the ground. This involves the question of mapping vegetation, the structure of the units and their relation to one another, a consideration of the factors of the habitat, in fact the synecology of the vegetation of the earth.

The book is profusely illustrated by diagrams and maps, there are a number of excellent half-tone plates mainly depicting South American plant communities, while the pen-and-ink drawings of vegetation are delightful. There is an adequate, though selective, bibliography and an index. This is an excellent book, but the condensation necessary to cover all aspects of the subject in a limited space makes it hard reading.

N. L. BOR

DARWIN'S BIOLOGICAL WORK: SOME ASPECTS RECONSIDERED. Centenary Essays. Edited by P. R. BELL. *Camb. Univ. Press*, 1959. $9\frac{1}{4} \times 6$ *inches;* xiii+343 *pages; plates, text figures.* 40*s*

The contributions of Charles Darwin encompass the whole field of biology, but are never superficial, and several of them have not yet been superseded. The present publication comprises six essays, each by contributors actively engaged in biological research, which once again demonstrate the width of Darwin's interests and ability as a biologist, apart from his great unifying work on evolution. The first essay, by P. R. Bell, deals with the movement of plants in response to light; then J. Challinor discusses palaeontology and evolution and gives some interesting examples of evolutionary series, especially of invertebrates. J. B. S. Haldane contributes a chapter on natural selection, and concludes with the remark that his own life has been largely devoted to working out the full consequences of Darwinism. P. Marler, lecturer in animal behaviour at the University of California, Berkeley, gives an interesting account of developments in the study of animal communication, with special reference to recent work, and points out that after Darwin's book 'The expression of the emotions in man and animals,' the subject lay fallow for half a century and had to be rediscovered. H. L. K. Whitehouse deals with cross- and self-fertilization in plants, and the book concludes with a section "Buffon, Lamarck and Darwin: the originality of Darwin's theory of evolution," by J. S. Wilkie. This collection of essays can be recommended not only to scientific readers but also to all those with a general interest in the subject.

EDWARD HINDLE

HUMAN AND HISTORICAL GEOGRAPHY

THE TROPICAL WORLD. By PIERRE GOUROU, *trans.* E. D. LABORDE. 2nd ed. *London: Longmans*, 1958. $9 \times 5\frac{3}{4}$ *inches;* 159 *pages; maps and plates.* 20*s*

It is good to see that a new edition of this important little book has been called for only five years after its predecessor. Most of the text remains unchanged, but the additions and deletions are significant; for, in tune with recent research and thinking, they tend on the whole to give a more hopeful picture of the humid tropics and a more charitable interpretation of the relative backwardness of many tropical peoples. It is a pity that mistakes in translation from the French have been repeated: for example the faulty conversion of kilogrammes per hectare to bushels per acre on p. 15.

B. H. FARMER

STUDIES OF HIGHWAY DEVELOPMENT AND GEOGRAPHIC CHANGE. By WILLIAM L. GARRISON, BRIAN J. L. BERRY, DUANE F. MARBLE, JOHN D. NYSTUEN, RICHARD L. MORRILL. *Seattle: University of Washington Press*, 1959. $10\frac{1}{2} \times 7\frac{1}{2}$ *inches;* 294 *pages; maps, diagrams.* $7.50

This volume consists of a series of essays and is to be followed by another volume

dealing with the "Central Business District and Urban Freeway Development." It is very much a background study which investigates the impact of road facilities on the business activities of communities. After the introductory chapters there are detailed analyses of highways and retail business, highways and urban residential land use, customer movement and retail business location. There is also a special study of highways and services, taking "physician care" as an example of a service industry. Results of improved highways are analysed for selected areas and it is clearly shown that improved roads do not necessarily mean the relieving of congestion. Non-vehicular changes include such items as drainage alterations and adjustments in property values, both of which may be for better or for worse. Some of the authors develop mathematical formulae for assessing the significance of these changes.

There are many good maps, well reproduced by lithography, and interesting diagrams and tables with the associated mathematical calculations not usually found in a geographical text. There is an emphasis on geographical factors which are so often either treated lightly or neglected in studies on communications, and this volume is to be commended as showing the way in which information on benefits from highway improvements can be examined. The task was undertaken to elucidate the effects of highway improvement with particular reference to taxation and while the volume is, of course, concerned with American conditions it is of particular interest in Britain.

A. C. O'DELL

MÉTROPOLES ÉCONOMIQUES. By JEAN CHARDONNET. Cahiers de la Fondation Nationale des Sciences Politiques. *Paris: Armand Colin*, 1959. $9\frac{1}{4} \times 6\frac{1}{4}$ *inches;* 270 *pages.* 1200 *frs*

This forms a companion volume to the author's 'Les grands types de complexes industriels.' Here he studies twelve large cities which "do not constitute simple examples; for very diverse factors may intervene to explain their present importance." There are two objectives: to fill a gap in the literature about certain large cities; and to show the reader that "economic reality is often in fact too complicated to be confined within over-rigid classifications, with the exception of certain simple cases, which are perhaps less numerous than one thinks." We are thus presented with a series of monographs, some of which certainly achieve the first objective of the author. The industrial diagrams are particularly useful. But one cannot feel that the documentation is complete. There is no reference to detailed works on the physical sites and situations of the cities, and few histories are quoted, though some effort is made to trace a historical development. Thus readers of English may well turn elsewhere rather than rely on the chapters on London and New York.

It is disappointing that the author essayed no general statements about the cities he visited. Or had they nothing in common except their complexity, and their ability to be united under the vague enough title chosen? But seven are seaports, four have close links with the Rhine; many have similar industries. If the functions of towns are studied, comparisons may become possible between them, so that one learns more about each. If one studies (*pace* Lincoln) "all the functions of all the towns all of the time" it is difficult to avoid a series of expanded encyclopaedia entries. This has undoubted reference value. So here are the twelve cities presented, as in the book, *seriatim*: London, Amsterdam, Antwerp, Liège, Frankfurt-Mainz, Mannheim-Ludwigshafen, Nuremberg, Linz, Barcelona, Genoa, Naples, and New York.

JAMES BIRD

GEOGRAPHY OF IRON AND STEEL. By NORMAN J. G. POUNDS. *London: Hutchinson's University Library*, 1959. $7\frac{1}{2} \times 5$ *inches;* 192 *pages; maps, diagrams.* 10*s* 6*d*

This is a readable account of the history of the growth of the iron industry, the characteristics of the various ores, and the geographical distribution of sources of the metal and of its industrial preparation for use. To cover the whole world in the compass of so small a book necessarily involves the loss of much detail; hence,

the second and more geographical part of the book gives only a distant bird's-eye view of iron production in the various countries of the world. Yet there is everything that the intelligent person who is not a technician would wish or need to know about the subject. The author, who is an established authority on industrial geography, is especially interesting on the development of the industry in countries behind the Iron Curtain and in the potential of those not usually regarded as industrial. In these, however, his information must of necessity be less firmly based. The countries behind the Iron Curtain deliberately draw a veil over much of their industrial affairs, and few of the non-industrial countries publish reliable statistics. One feels, nevertheless, that the author has reached a close approximation to the truth. His view of Soviet production and resources is cautious and reasonable, and he points out that there was a considerable production of iron in Russia before the Revolution in 1917, a fact usually overlooked in Communist propaganda. E. D. LABORDE

THE TROUBLESOME VOYAGE OF CAPTAIN EDWARD FENTON 1582–1583. Narratives and Documents, edited by E. G. R. TAYLOR. Works issued by the Hakluyt Society, 2nd ser. CXIII. *Cambridge University Press for the Hakluyt Society*, 1959. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches*; xii+334 *pages; maps, illustrations.*

Professor Taylor has added to her already great services to the Hakluyt Society, and to Elizabethan scholarship, by extracting and editing the documents on Fenton's voyage. The majority of them are in Otho E. viii, a volume of the Cotton MSS. salvaged from the fire at the Cottonian Library in 1731. The volume is so burnt that the top lines and part of the sides of each leaf are lost. This makes it difficult to reconstruct the sense of some passages and even to recognize the bearing of some documents. The two longest and most important, Fenton's own journal and the private diary of Richard Madox the chaplain, are not in the damaged volume, but have not provided easy work for the editor, Madox being partly in cipher.

When Drake came home in 1580 his booty gave rise to a crisis with Spain and much excitement in England. But cool observers saw more importance in the fact that he was the first English captain to have seen the Moluccas and to have sailed through the great archipelago of South-east Asia. The Moluccas with their spices were still the most desirable commercial goal in the world, and Drake had traversed both the routes by which they could be reached. Projects for the establishment of a regular English trade were discussed, and one of these came to action in the expedition commanded by Edward Fenton. It was sometimes referred to as Fenton's China voyage, although its declared objective was not China but the Moluccas. It was a total failure since Fenton did not complete even the Atlantic stage of his outward passage.

The cause of the failure, as Professor Taylor shows, was partly that a delayed start precluded arrival at the Cape at the best season for favouring winds; but even more it lay in the character of Fenton, who aspired to play Drake without having the ability to do so. He was instructed to make a purely trading voyage without seeking hostilities anywhere. He showed from the outset that the instructions meant little to him and indulged in dreams of grandeur and high-handed achievement, while displaying so little leadership that the self-willed adventurers in his fleet were condemning him as a fool before they were clear of the Channel. Fenton could make nothing of them, and did not deserve to, for he was as unscrupulous and undisciplined as anyone else.

The editor's introduction brings out these personalities. Her own preference—and it must be ours—is for Richard Madox, who did his best as a Christian minister to keep people straight, fitted himself with charity and good humour into a jangling society of self-seekers, and died four months before the ships came home.

J. A. WILLIAMSON

MILITARY ASPECTS OF WORLD POLITICAL GEOGRAPHY. U.S. Air Force Reserve Officers Training Corps, Air University, Maxwell Air Base, Alabama, 1959. $10 \times 6\frac{1}{2}$ *inches;* 550 *pages; maps and photographs; index*

It is (or should be) axiomatic that a sound foundation in military and political geography plays an essential part in the education of a soldier, sailor or airman; it is

refreshing to see this requirement taken so seriously by those responsible for the training of Air Force Reserve Officers in America. This textbook, a compilation made under the recommendations of the Association of American Geographers, is extremely comprehensive, no aspect of the subject being overlooked. The opening chapters deal with the basic facts and principles concerned: Political and military geography; Globes, projections and maps; Global strategic views; Geography of climate; Factors influencing the power of states. The subsequent thirteen chapters discuss in turn the different regions of the world, beginning with "Anglo-America" and ending with "Antarctica." In the chapter entitled "Global strategic views" the doctrines of Admiral Mahan, Mackinder and Fairgrieve are well summarized and brought up-to-date by references to the publications of Sir John Slessor and Alexander de Seversky, but the effect of nuclear weapons, although discussed, is by no means conclusively clarified.

The recent history of racial and strategic conflicts is adequately dealt with, such subjects as the Suez crisis of 1956, South African "apartheid," and the Federation of Rhodesia and Nyasaland, being well and impartially presented. The maps are, in general, clear and instructive. The one on page 374, illustrating the political distribution of African territories in 1940, shows Egypt as "U.A.R.," whereas the United Arab Republic was only created in February 1958. The numerous photographs are neither very well chosen nor very clearly reproduced, but the text throughout is admirably compiled by experts who know their subject. A British version would not be out of place as a textbook in our own military and air force training colleges.

JAMES MARSHALL-CORNWALL

APPROACH TO ARCHAEOLOGY. By STUART PIGGOTT. *London: A. & C. Black*, 1959. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches; 134 pages; plates and figures.* 15*s*

Professor Piggott's admirable little book supplies a long felt want, a comprehensive and logical approach to archaeology. It sets out, in plain and lucid language, the "ideas and concepts" which lie behind all forms of the discipline, field-work, excavation and "indoor" research of all kinds. Among the general public, for whom this book is designed, there are, in fact, various widespread, partial and imperfect approaches to archaeology. First, there is the practical enthusiast. Almost until the war excavations were conducted without benefit of technical text books and training digs were unheard of. These deficiencies have now been remedied, but this book will broaden the outlook of the practical worker and remind him of the real objects in view. Secondly, there is the armchair archaeologist who is well catered for by a spate of popular works on the most spectacular excavations. This book may cause him to reconsider the idea of archaeology as a treasure-hunt for *objets d'art*. Thirdly, there is a numerous class, slightly better informed than the last, who are both critical and sceptical and tend to regard archaeologists as people engaged in grubbing for broken bits of pottery and making little round depressions in the ground and calling them "post-holes." For these this book should bring enlightenment and, it may be hoped, conversion. This is all the more likely because the limitations of the discipline are constantly stressed and its interdependence on workers in the fields of the natural sciences and humanistic study. "Archaeology is in fact a branch of historical study," and, "although the archaeologist utilizes these scientific methods he does not turn his study into a science by so doing." But it is the secret of the latent popularity of archaeology that it makes its appeal to people of both types of mind. For the moderate price the allowance of illustrations is generous and they are singularly well chosen, including some beautiful drawings by the author, though some of the line figures have had to suffer from rather too severe reduction. EDWARD HILDYARD

CORRECTION TO *GEOGRAPHICAL JOURNAL*, MARCH 1960

'The geology of South Australia' and 'The stratigraphy of Western Australia,' reviewed on page 89 of the March *Journal*, were both published by the Cambridge University Press as agents in this country for the Melbourne University Press, given in our review as the sole publisher of both books.

SHORTER NOTICES

GÉOLOGIE DE LA RÉGION PARISIENNE by R. Soyer and A. Cailleux (*Presses Universitaires de la France*, 1959) summarizes, in one small volume, the many studies which have been made of the Paris region, an administrative name for the area within a radius of 30 kilometres from Nôtre Dame. The rocks mainly in question are the lower Tertiaries of the wider region of the Île de France. The treatment is in general stratigraphical with short chapters on tectonics, applied geology, hydrogeology, and on the discovery of oil since 1954. There is no analysis of the evolution of surface forms in detail. The work concludes with a very brief bibliography. G. R. C.

* * *

THE RAILWAYS OF FRANCE, published by the Société Nationale de Chemins de Fer, Paris, and issued in an English version by French Railways Ltd., London, is another edition (1959) of the booklet published in 1955. Since the War, French railway engineers and operators have introduced reforms in railways which have given a lesson to railway administrations elsewhere, and this booklet is to be commended for the way in which it shows the present situation of French railways. Within the 98 pages it contains a short text which covers all the important features of railway organization, but the great strength of the publication is in its amazing assemblage of photographs and diagrams. Geographers unfamiliar with railway movement of traffic will gain particular value from the material on goods services. All who are interested in a study of the future role of railways would be well advised to consult 'The railways of France' as, from the pioneer work which has been done by the French railway administration in such fields as electronics applied to railway operating, there are many lessons to be learned. A. C. O'D.

* * *

Between the wars Mr. T. A. Layton's attractive and inexpensive restaurants were among the first to serve wine by the glass to London's office workers at their lunch. Indefatigable as ever in his pursuit of interesting vintages, he describes a recent journey in WINES AND CASTLES IN SPAIN (*Michael Joseph*, 1959, 21*s*), a discursive travel book in which many curious and amusing characters are described. Mr. Layton is perhaps a trifle testy with the devotees of the *mañana* philosophy whom he meets, but his narrative has an individual flavour and contains much interesting information. D. M.

* * *

In THE ROAD TO ANGKOR (*Robert Hale*, 1959, 18*s*) Christopher Pym describes a journey that he made in 1957 from Binh Dinh, on the east coast of Viet Nam, to the Angkor in Cambodia. Because he travelled on foot, because he used local guides and lived with the peoples he met, and because he is clearly an acute and sympathetic observer, he manages in the course of his narrative to tell us a great deal about the many, varied and little-known peoples who live in the forested highlands he traversed. His book is easy to read, though some may find it a little unselective in its day-to-day account of happenings. There are excellent photographs and a number of maps and diagrams. One awaits with interest the author's more serious work on Angkor and Khmer civilization which he hopes to publish "in thirty years' time or longer if need be." B. H. F.

* * *

The review of the English version of JIVARO, GEHEIMNISSE DES AMAZONAS (*Gütersloh: Bertelsmann Verlag*, 1959) by Jorgen Bisch has already appeared in the *Journal*; 'Across the river of death' was reviewed in the issue for June 1959. The German version is a better book, both in text and photographs. The author's reputation was evidently not enhanced by his English translator, and the existence of the rhinoceros in the Amazon was his fiction, not Mr. Bisch's. P. B.

CARTOGRAPHICAL PROGRESS

It is proposed to allot in future a section of each issue of the Journal *to cartographical subjects. Thus all review articles, reviews and notes on cartography will be brought under one heading. Short notes of about 350 words on subjects of cartographical interest will therefore be welcomed for consideration. If the demand justifies it, it is further proposed to bind offprints of the section for each year into one annual issue.*—EDITOR.

DIE KARTEN DEUTSCHER LÄNDER IM BRÜSSELER ATLAS DES CHRISTIAN S'GROOTEN (1573). Edited by HANS MORTENSEN and AREND LANG. *Abh. Ak. Wissens. Göttingen*, Philol-Hist. Kl., 3. Folge, nr. 44. *Göttingen: Vandenhoeck & Ruprecht*, 1959. I. *Karten:* 27½×24 *inches;* II. *Textband:* 10×6½ *inches;* 80 *pages*

This fine set of reproductions is an important contribution to the history of cartography. Though the name of the surveyor-cartographer is known to students, this work presents the first convenient opportunity of appreciating his contribution as a whole, and it also portrays the standard of cartography in Western Europe in the second half of the sixteenth century. Christian s'Grooten was born in a hamlet near Xanten, probably some years before 1530. He is first known from the year 1548, and nine years later was described as cosmographer to the King, *i.e.* King Philip II of Spain. He was engaged in map-making from an early age, but the achievement for which he is now best known was completed in 1573. As a protégé of the Duke of Alva, he was entrusted with the mapping of areas adjacent to the Spanish domains in the Low Countries which were of special interest to the authorities. For his services he finally received a sum of 24,344 livres, regarded by some as the highest reward ever paid to a cartographer. He died at Kalkar in 1603–04. A number of s'Grooten's maps were published, including a rare nine-sheet map of Germany, 1565, of which two sheets are in the Society's collection. His important work, however, remained in manuscript, being prepared for official use, and accordingly considered secret. This manuscript atlas remained unknown for long in Spain, but is now in the Bibliothèque Royale, Brussels. A second atlas of Europe, containing thirty-eight improved maps in manuscript, was completed in 1592, and is now in the Biblioteca Nacional, Madrid. The publication under review contains collotype reproductions of the maps in the Brussels Atlas, twenty-eight in all, of German interest—two general maps, twelve special maps of German territories bordering the Spanish Netherlands, and seven maps of most of the remaining German area. The latter are on smaller scales, and are mostly based on earlier maps.

The second section of special maps is the individual contribution of s'Grooten. They cover approximately the area between the North Sea, the Weser and the Mosel; drawn generally on about the scale of 1:230,000, they are often the earliest detailed maps of the districts concerned. They show a high standard of artistry in execution; hills, woods, and especially towns, are carefully drawn, and in some parts the representation resembles a panorama.

We do not know the methods which s'Grooten employed, but it is possible to deduce from the maps a good deal about the way he went to work. It is unlikely that he made any astronomical determinations of position—the special maps have no meridians or parallels—but employed a rough form of triangulation, taking rounds of angles from conspicuous view-points, and measuring with some care distances between various places to provide base lines. As he gives a time scale on his maps (*e.g.* 3 hours journey equals 2 common German miles) it is probable that many distances were determined by travel time. It is also probable that, following Apian's advice, he obtained much data from well-informed local inhabitants. The hydrographical network is particularly well developed, though some of it is stigmatized by the authors

as "phantasy" and there are other topographical features which fall into this class. It may be that in some instances, *e.g.* the Ijssel, he followed the course of a river and fixed localities in relation to it. There is an astonishing wealth of detail in many districts—the smallest hamlets, castles, bridges, fords, windmills, etc., are entered, pointing to personal investigation; negative evidence in favour of this is that in areas difficult of access, such as extensive stretches of wooded heights, settlements rather fall into the background. Administrative boundaries caused considerable trouble; partly due to their number—a characteristic of German life—but also to their fluctuation, and the natural reluctance of local worthies to particularize them. Some of the maps show important trade routes, probably based on itineraries, and the general map of north-western Europe has sea routes as well, with the points at which changes of course should be made.

Taken as a whole, s'Grooten's work reaches a high standard, if it does not quite attain that of Mercator's best work. Another contemporary with whom he may be compared is Christopher Saxton, who was working at approximately the same time. There is little doubt that both used very much the same methods, though Saxton's work is perhaps not as detailed. The Yorkshire cartographer was less troubled by boundaries since he was concerned with the limits of counties only. He had one great advantage over his contemporary in that his maps were engraved and published, to influence English cartography for two centuries, while those of s'Grooten remained in manuscript and neglected for nearly four centuries.

The editors of this work have provided a careful commentary on each of these reproductions, which include one sheet in colour as a specimen, and in particular a very thorough bibliographical apparatus, thereby earning the gratitude of all students of the history of cartography. G. R. CRONE

LANDFORMEN IM MITTLEREN EUROPA: MORPHOGRAPHISCHE KARTE MIT RELIEFENERGIE, 1:2M. By H. WALDBAUR. *Wiss. Veröff. dtsch Inst. Länderk. Lpz.* N.F. **15/16** (1958), *text, pp.* 133–77; *map at end of volume*

The publication of the 'Atlas des deutschen Lebensraumes im Mitteleuropa', edited by Prof. N. Krebs, began just before the war. It has not been completed, for an atlas of the middle of Europe as the home of Germans would carry too many political implications. This map of the morphology and of the emphasis of the relief (*Reliefenergie*) in Central Europe was intended for this atlas, but now enjoys the advantages of twenty years of experiment and improvement and of a scale not fixed by that of the atlas. The author explains his meticulous methods and intentions on pp. 133–72 of this publication and five pages of useful bibliography on this type of map is appended.

The map must be accounted a success in depicting the shape of Central Europe between approximately 45° and 55° N. and 2° and 23° E., for it is not only a pleasant map but also a lucid document. The relative relief is depicted in eight graded colours showing height-differences within 5 kilometres horizontal distance, two grades providing for dead flat and low relief and six for gradations of less than 50 metres, 50–100, 200–300, 500–1000, 1000–2000 and greater than 2000 metres. Brown lines record changes of slope with convex and concave transitions of various grades of emphasis. Certain valley details are also shown in brown, while numerous water features are in blue.

The detailed morphology in black is very well-defined. While a causal interpretation and pure geology are not the main theme of the map and the emphasis is on land forms, the geological basis is clear. Thus, ancient and recent fold mountains and the sedimentary cover are shown and there are signs for the chief rock types. In addition to the geological data most types of relief, whether those to be distinguished by their form or their origin, are clearly shown. All types of culmination in the relief are indicated, *e.g.* folded mountains, volcanoes and domelike forms, as also are steplike features and those related to faults. In addition, ridges and water partings are clearly indicated in their varieties. The map not only emphasizes the basic morphology of

Central Europe and can be read at a glance, but in detail, and because of its high standards of accuracy, is a valuable aid to the scholar. D. J. DAVIS

ATLAS OF CANADA. *Ottawa: Department of Mines and Technical Surveys, Geographical Branch*, 1957 (*published* 1959). $20\frac{1}{2} \times 15\frac{1}{2}$ *inches;* 110 *plates.* $25

The first official Atlas of Canada, prepared under the direction of James White, geographer, was published in 1906 by the Department of the Interior of the Canadian Government. A revised and enlarged edition, prepared under the direction of J. E. Chalifour, Chief Geographer, followed in 1915 using many of the same plates but relettered in more modern style, as well as incorporating later material. Both were noteworthy pioneers when relatively few countries had accepted the idea of a national atlas, which should attempt to show in cartographic form the many and varied phases of national life as well as the general physical and political geography of the country. In the years which followed the First World War few countries advanced with more giant strides than did Canada and in 1948 the preparation of a new National Atlas was authorized by a decision of the Cabinet. Under the Department of Mines and Technical Surveys the Canadian Government had then recently established a Geographical Branch and had appointed as its Director Dr. J. Wreford Watson, now Professor of Geography in the University of Edinburgh. In thus establishing a government organization specially to undertake geographical investigations on behalf of other departments—as distinct from the work of actual map production which is proper to the Surveys and Mapping Branch—the Canadian Government was again a pioneer and it was natural for the preparation of the new atlas to be entrusted to the Geographical Branch. Eight or nine years of careful planning and research and an untold amount of devoted cooperative labour have preceded the triumphant production of what is indeed a magnificent work, both in its comprehensive cover and in the technical excellence of its presentation.

As Paul Comtois, Minister of Mines and Technical Surveys, says in his foreword, "the purpose of the Atlas is to present in maps an outline of the physical background and the economic development of the nation at mid-century, and to show how these factors are interwoven to produce the fabric of the life of our people." In his introduction Dr. Norman L. Nicholson, the present Director of the Geographical Branch, modestly forebears giving details of the many difficult problems it fell to his lot to resolve, and simply mentions some salient facts. The projection chosen for practically all the maps is the Lambert Conformal Conic, with 77° N. and 49° N. as the standard parallels and some slight modification in the far north. The basic standard scale is 1 : 10M. (approximately 158 miles to one inch) and on this scale the whole of Canada is shown in one double spread. Incidentally the 110 sheets are linen-hinged and removable from the strong loose-leaf binder; the use of a 1 : 20M. scale permits four maps to the double page and there are large numbers of distribution maps on smaller scales.

The Atlas begins with a number of historical maps, including routes of explorers. Excerpts are given of many early maps, redrawn for the purpose but as far as possible with the use of the original lettering and ornamentation and reproduction in original colours. The state of mapping in Canada's 4,000,000 square miles—including adjoining seas—is shown and includes a complete cover on the 1 : 1M. scale. Specimens are given of the various series on different scales.

After the usual bathy-orographical maps it is Plate 13, Physiographic Regions, which arouses a major comment, and perhaps the most serious criticism of the Atlas. The delineation of any system of regions, including physiographic regions, is a subjective approach: it is a largely individual interpretation of the recorded facts. As on other maps, the sources of information are vaguely acknowledged—in this case to the Geological Survey and the Geographical Branch, but one would like to know on whose authority the delineation was made. Plate 14 is taken directly from Chapman and Putnam's work on Southern Ontario and is so acknowledged, but in practically no other case are any acknowledgements given to individuals. The map of Glacial

Geology (Plate 15) is really exciting. Who did the interpretation of a vast amount of scattered information? We are now becoming accustomed to the idea that when vast ice-sheets of unknown thickness covered the heart of Canada, most of Alaska and with it the Yukon border remained unglaciated, and on Plate 15 the "northward limit" of the great ice sheets is boldly indicated. This seems to link with the map of January mean temperature where Canada's "Cold Pole" is around Baker Lake (−30° F.). On the other hand the lowest recorded temperatures (below −80° F.) are in the Yukon. The many climatic maps bring out some of the remarkable Canadian contrasts—the frost-free period exceeding 240 days at Victoria, but the longest growing period (more than 4000 "degree days") in the Ontario Peninsula. On the explanatory note to Plate 30 one reads, with some regret in the light of later work, that the "most widely accepted system of climatic classification" in Canada is Köppen.

Progress in detailed exploration of the far north is well seen in many maps. Dotted coastlines have been replaced by firm lines; the map of solid geology has very few remaining white areas and one begins to pick out the structural lines in the Canadian Arctic islands contrasting strongly with the monotonous Shield. In many cases a highly generalized map—as of soils, natural vegetation and forests—is accompanied by specimen extracts illustrating the detailed work in progress or undertaken in special areas. A striking map is that of Parks and Faunal Reserves—Canada at least has attacked the problem of Nature conservation while there is yet time.

The very long series of maps relating to demographic, social and economic geography relates to the years 1951–7; population and crops to 1951, mines and minerals to 1955 (pipelines to 1957), airports to September, 1957, railways to 1957, hydro-electricity and manufacturing to 1954. Throughout, the treatment is always imaginative, never stereotyped; the reader is likely to be interested in the distribution of the larger mammals, and so it is they which appear on distribution maps; an area of special interest is the Sudbury ore-field and it is given a special map. Again one would like to know who decided the categories for the Agricultural Regions map—four main classes according to "percentage of total gross farm revenue obtained from a particular source."

Still other novel features appear in the later plates. By the use of very small type it has been possible to show in a series of provincial maps practically every inhabited place and in an exhaustive gazetteer, printed on the map, to find the position and often the size of a remote settlement. Instead of the conventional town maps we are given eight pairs—for Quebec, Montreal, Toronto, Ottawa, Winnipeg, Edmonton, Vancouver and Victoria—of urban land use maps on the scale of 1 : 100,000 together with development maps showing the growth of each. This is part of the work which the Branch is doing in land use survey, along the lines suggested by the Commission on a World Land Use Survey of the International Geographical Union.

The final plate of an Atlas it would be difficult to overpraise reminds Canadians of their world obligations—membership of the Commonwealth, the Colombo Plan, NATO (and connections with OEEC) and UNO. L. Dudley Stamp

INTERNATIONAL CARTOGRAPHIC ASSOCIATION

A Conference was held in Berne in June 1959 to discuss the creation of an organization for international cooperation in cartography, which was attended by delegates from these thirteen nations—Austria, Belgium, Finland, France, Great Britain, Germany (West), Italy, Netherlands, Norway, Spain, Sweden, Switzerland and the U.S.A. The British delegate representing the British National Committee for Geography of the Royal Society was Brigadier L. J. Harris of the Ordnance Survey. At this conference the resolution "To create an organization for the purpose of extending international cooperation in the field of cartography and for the purpose of joining with the IGU as an affiliated organization with sufficient autonomy" was adopted, and the International Cartographic Association was thereby formed.

At the forthcoming International Congress of Geography in Stockholm in August of this year, affiliation with the IGU will be sought and the necessary preliminary

discussions between the representatives of the IGU and the International Cartographic Association are now proceeding.

Subsequently it is proposed to call a delegates' meeting in Paris in April 1961 for the purpose of: (1) receiving the result of this application for affiliation and dealing with matters arising from it; (2) electing a new Bureau to succeed the present interim Bureau or Committee of Management; (3) approving the statutes for electing new members; (4) deciding on the date of the next technical convention.

The beginnings of this international organization for cartography can be attributed to the success of an informal cartographic conference organized by the commercial firm of Esselte in Stockholm in 1956, which was attended by invited delegates from ten different countries. The idea gained strength from the resolutions passed at a second international cartographic conference held in Northwestern University, Chicago, in June 1958, arranged by the commercial firm of Rand McNally & Co. of Chicago, and in the following November the idea was accepted as an aim at the Mainz Conference called by the German Cartographic Society to consider the specific question of an international organization for cartography. The Mainz meeting led to the final meeting at Berne at which the International Cartographic Association was established.

The purpose of the Association is the encouragement of the science and techniques of cartography as a theory of representation and as a science of cartographic drawing and reproduction techniques. It is felt that in this field at the present time techniques are developing very quickly and there is great benefit to be obtained by drawing attention to them and by exchanging experiences—aims which cannot be sufficiently realized by the existing geodetic, photogrammetric, geographical and other associations.

The Association believes that affiliation to the International Geographical Union will be for the mutual benefit of both organizations and will be profitable for both geography and cartography. Membership of the Association is open to all member countries of the International Geographical Union who are willing to cooperate actively in the exchange of ideas, but each nation may only be represented by one organization. Individual persons cannot be admitted as members of the Association. The statutes of the Association are still in the process of being prepared, but it is envisaged that a Technical Congress will assemble about every four years and special meetings and working groups will be arranged by the Assembly of Delegates or by the Bureau to operate between the Technical Congresses. L. J. HARRIS

THE WORK OF THE ORDNANCE SURVEY

The Annual Report of the Ordnance Survey for 1958–9 records some interesting developments, particularly in the closer coordination of its work with the needs of its users, mainly in regard to the new 1 : 2500 series. In future the plans will cover 2 km. × 1 km. instead of 1 km. × 1 km., and acreage will be measured to one-hundredth of an acre and not to one-thousandth. It is estimated that, in conjunction with a new device for measurement, this will effect a saving of three to four million pounds over the whole series. The new series of the 2½-inch map is to be reduced directly from the 6-inch, thus securing a further considerable saving, and the sheets are to be enlarged to cover 20 km. × 15 km. The 6-inch plans of the Highlands, being produced by air survey, are to show rock faces and outcrops in much greater detail, so that their value to mountaineers will be increased. Progress has also been made in the development of hill-shading, a technique which has only recently been reintroduced. The publication of a new period map, 'Southern Britain in the Iron Age,' is announced for 1960. It is proposed that the rights of way as defined by the National Parks Act of 1949 will be shown on the 2½-inch and 1-inch maps, as the surveys by local authorities become available.

The report is accompanied by a number of useful maps, showing, among other things, the "Basic scales of mapping" (urban areas 1 : 1250 resurvey; rural areas 1 : 2500; mountain and moorland areas 6-inch), the progress of secondary and tertiary triangulation, and the beginning of the One-inch Seventh Series revision.

THE MAP DIVISION, LIBRARY OF CONGRESS

The Library's comprehensive acquisitions policy for cartographic material encourages the procurement and retention of at least one copy of each edition of every map, atlas, globe and other form of cartographic publication with any reference value, whether the materials are old or new, commercial or official, foreign or domestic. The collections are growing at the rate of some 90,000–100,000 maps and 1200–1500 atlases per year. These materials are acquired through many channels. Transfers from more than 20 Federal Agencies account for approximately 58 per cent. of the accessions. About 17 per cent. of the accessions result from regular exchange agreements plus a few specific negotiations like that by which the Library of Congress acquired this year from the Bibliothèque Nationale a copy of the Augustine Herrman Map of Maryland and Virginia, published in 1673. Current maps from government sources constitute 14 per cent. of the accessions. Of special interest among the maps acquired from the U.S. Geological Survey are the many new city and vicinity maps as well as topographic sheets of the United States at 1 : 250,000. Approximately 8 per cent. of the accessions are acquired by purchase, 2 per cent. by copyright and 1 per cent. by gift. Of the gifts, nearly all are retrospective and some are quite rare. The Library was especially fortunate to receive last year from Mr. Melville Eastham a collection of nine distinctive and representative atlases of the sixteenth century, beginning with the Latin edition of Ortelius's 'Theatrum orbis terrarum' (1571). Recently the Library received from Carl I. Wheat the third volume of his monumental work on 'Mapping the Transmississippi West,' published by the Institute of Historical Cartography, San Francisco.

The Map Division now has custody of more than 2,400,000 maps and 20,000 atlases in addition to many globes, models and other forms of cartographic publication. It is not possible with the small staff of the Division to catalogue for printed cards more than 1 or 2 per cent. of the annual accessions, but a catalogue of printed cards with author-title entries would be of relatively little use anyway in a Division where requests for material are almost exclusively by area-subject. The topographic sets and series are, however, recorded on graphic indexes to show the extent of coverage. General reference maps are titled to aid in filing and in finding them for reference use. The titling slip shows the area, sub-area, subject, date, scale and authority for each map. The unfortunate aspect of this situation is the lack of cross-reference flexibility and positive identification of each item which a properly organized card catalogue could provide. The map files must serve, in effect, as their own catalogue.

The Map Reading Room is open to the public, but most of the reference service is to Members of Congress and Government agencies by telephone and through correspondence. The services of the Division are further extended through exhibits, photoduplication of non-copyrighted materials, interlibrary loans to foreign as well as domestic libraries, and the publication of bibliographies.

A list of publications prepared in the Map Division may be obtained without charge from the Division office. Among those in preparation is Vol. 6 of 'A list of geographical atlases in the Library of Congress,' which will include nearly 2000 atlases of Eastern Hemisphere areas received since 1920. (For a note on Vol. 5, see this *Journal*, **124** (December 1958), p. 570.) Staff members of the Division are now cooperating in the compilation and editing of 'A guide to cartographic research,' to be published by the Special Libraries Association.

ARCH C. GERLACH

NAMES IN CZECHOSLOVAKIA AND BULGARIA

The Permanent Committee on Geographical Names has recently published two further issues in their new series of Lists of Names, No. 3, Czechoslovakia and No. 4, Bulgaria. Both are regions in which several languages have been predominant at various times for rendering place-names and in which extensive changes have recently been made. In each case, the official forms of names are listed alphabetically with their geographical coordinates; an indication of the position relative to the administrative centre of the district, and any superseded forms. In some cases English usage

is quoted, *e.g.* České Země, Czech Lands, a modern province incorporating most of what was formerly known to English readers as Bohemia and to Germans as Böhmen. The Bulgarian list is alphabetized under the transliterated forms of the official names in Cyrillic. Numerous complete changes of name are also included; *e.g.* Shumen is now Kolarovgrad, and Karlovo is Levskigrad. Each list includes indexes of names in other languages referred to, *i.e.* for Czechoslovakia, German, Hungarian and Polish; for Bulgaria, Cyrillic, Romanian and Turkish. The value of such lists to geographers, historians and other scholars, and to all map-users is plain. Copies may be obtained from the P.C.G.N. at the Society's House, at 37*s* 6*d* each plus postage.

TURKISH MAPS

Maps and geographical publications in Turkey are difficult for the foreigner to locate. Scholars visiting the country or doing research outside Turkey are thus frequently unaware of the existence of essential material or are unable to procure it. In view of the growing interest in Asia Minor and the increasing number of scholars and tourists visiting the country, it seems desirable to review summarily the existing maps, which should not only be of interest to geologists and geographers, but also to archaeologists, foresters and other experts as well as tourists. For general orientation the Turkish School Atlas (Büyük Atlas) contains maps on the scale of 1 : 2M. and smaller maps giving climatic, economic and other information. Topographical maps on various scales are issued by the military department of the Harita Umum Müdürlügü (Ankara, Cebeci).

The 1 : 800,000 series covering Turkey in eight sheets is also extended to cover the adjoining areas (Belgrade, Bucharest, Salonika, Athens, Crete, Lebanon, Syria, large parts of Iraq, western Persia, the Caucasus and southern Crimea).

The 1 : 200,000 series has only recently been made available to the public. As supplies are low some sheets are not available or the sale may be stopped altogether for a time. This map is being revised; the newly prepared sheets are of high quality, being based on the photogrammetric survey at present being conducted for the 1 : 25,000 series. These sheets are well executed and give varied detail, marking tumuli for instance. The 1 : 25,000 series, which already covers large parts of the country, is of outstanding quality. It is, however, strictly secret and only available to experts working for the government. The town plans of Istanbul (1 : 15,000) and Ankara (1 : 8000) are useful for general orientation. They are however very outdated as both cities are constantly undergoing change.

A series of geological maps may be obtained from the M.T.A., the State department for geology and mining (Ankara, Istanbul Cadde). The 1 : 800,000 is a very useful map for general orientation, although not without errors. Explanatory textbooks in French for the Istanbul and Izmir sheets are supplied together with the maps. The Ankara sheet is at present out of supply. A revised and improved map on the scale 1 : 500,000, which is to replace the above, is in preparation. For detailed work the hand-coloured sheets of the 1 : 100,000 series may be purchased. The uncoloured contoured sheets of this series, which are on sale at low cost, provide excellent basic sheets for the entry of data in the field. The 1 : 800,000 tectonic map is on view at the Ankara Institute, but is out of print. The M.T.A. has also published a map of coal, lignite and oil deposits on the scale of 1 : 2·5M. In addition to these maps the M.T.A. is issuing an annual bulletin (international edition available) which contains papers on recent research conducted within the Institute, as well as recent information on mining. A series of monographs have been published on various aspects of Turkish geology (lists of titles from the M.T.A.). Further, numerous unpublished reports may be studied at the M.T.A. Institute on obtaining permission. Most of the publications are available in English, French or German.

Miscellaneous map publications which are of interest include the following: A seismic map of Turkey on the scale of 1 : 2M. is published by the Ministry of Public Works, Ankara. A soil map (1 : 800,000) in four sheets with text by Harvey Oakes (Turkish and English edition) has been prepared by the Ministry of Agriculture

(Ankara, Atatürk Bulvari). An economic map (1 : 800,000) may be obtained from Istanbul University. Forest maps (1 : 800,000 and 1 : 2·25M.) are distributed by the Orman Umum Müdürlügü (Ankara, Atatürk Bulvari). These maps show the distribution of forest stands and the type of woodland (high stands, scrub mainly maquis, degraded forests). Further, a map (1 : 2M.) containing information on the dominant species within the stands is to be found in the book 'Gymnospermler' by H. Gökmen. A road map (1 : 1·625M.) may be obtained free of charge from the Tourist Office (Ankara, Anafartalar, or the Karayollari Umum Müdürlügü, Ankara, Tuna Cadde). It is indispensable to every scholar or tourist travelling in Turkey, as the older maps contained in standard guide books are in most cases now out-dated, owing to the roads now being constantly improved and extended. This map also gives useful information on the location of historic monuments. As a greater number of these were indicated on maps published prior to 1959, it is also advisable to try to get one of the older issues. Finally, the following climate maps are available: one published by the Meteorological Office, Ankara, showing the distribution of annual and seasonal rainfall, the other showing climate graphs for the major meteorological stations (Prof. Dr. U. Cölaşan, Ankara, Bahcelievler, 37 Sokak, no. 36). L. V. NESTMANN

EARLY MAPS IN THE BIBLIOTHÈQUE NATIONALE

The exhibition, "Enrichissements de 1945 à 1960" which opened at the Bibliothèque Nationale, Paris, in April allows the display of some early maps which have been acquired by the Département des Cartes et Plans in the last fifteen years.

On the walls of the Galérie Mazarine are hung some of the finest marine charts on vellum from the Archives du Service Hydrographique de la Marine, transferred to the Department in 1947: Planispheres of Caverio 1502, of Domingos Teixeira 1573, of Pedro de Lemos 1590; charts of the Mediterranean by François Ollives 1662, and J. F. Roussin 1672; of the Atlantic by Pierre Devaux 1613 and Jean Guerard 1627; of the Pacific by Hessel Gerritz 1622; of the Indian Ocean by João Teixeira 1649, and of the Arctic Ocean by Joris Carolus 1614. With these charts, known to all historians of cartography, are others hitherto less well known; a fifteenth-century nautical chart on vellum of the Mediterranean from the Archives de Lille, two fragments discovered in a binding of another chart of the Atlantic Ocean from the end of the sixteenth century, which may be attributed to Luis Teixeira; a chart of the Mediterranean by Jacobus Maggiolo 1573; and a small atlas on vellum undoubtedly by João Martinez, which belonged to the Chadenat Collection. From the same collection came the richly decorated "Cosmographie," drawn by Bartholomeu Velho for the King of France, Charles IX.

French cartography is represented among other manuscripts by a curious project for the control of the course of the Vilaine 1543, a map of Nouvelle France by J. L. Franquelin 1678, which shows all the French settlements, mural maps of Roussillon and the Cerdagne by La Blottière (1718) and eleven collections containing nearly six hundred maps and plans of the frontier regions of France brought together for Louis XIV. A fine Arab astrolabe of the thirteenth century, a pair of globes by Blaeu (64 millimetres in diameter) in a striking state of preservation, and a Japanese world map of 1680 complete a series which demonstrates the importance, in the field of early cartography alone, of the recent accessions to the collections of the Bibliothèque Nationale. M. FONCIN

THE SOCIETY'S NEWS

MEDALS AND AWARDS

Her Majesty The Queen has approved the award of the Royal Medals as follows: The *Patron's Medal* to Professor Théodore Monod, Director, Institut Français d'Afrique Noire, for geographical exploration and research in the Sahara; and the *Founder's Medal* to Phillip G. Law, Leader, Australian National Antarctic Research Expeditions, for Antarctic exploration and research.

The Council of the Society also announces the following awards: *Victoria Medals* to Dr. Armando Cortesão for studies in the history of Portuguese cartography; and to Professor J. A. Steers, Cambridge University, for research in coastal morphology; the *Murchison Grant* to Professor J. Wreford Watson, Edinburgh University, for contributions to the development of geographical studies in Canada; the *Back Grant* to A. T. Grove, Cambridge University, for geomorphological studies in northern Africa; the *Cuthbert Peek Grant* to G. F. Reid, Directorate of Overseas Surveys, for contributions to Antarctic surveying; the *Gill Memorial* to Dr. Joyce M. Lambert, Southampton University, for research into the origin of the Norfolk Broads; the *Mrs. Patrick Ness Award* to Dr. R. J. Adie, Birmingham University, for contributions to Antarctic geology.

VISIT OF THE PRESIDENT OF PERU

His Excellency the President of Peru and Señora de Prado visited the Society's House on 25 February 1960, where they were received by the Rt. Hon. Lord Nathan, President of the Society, and Lady Nathan, and Officers and Members of the Council. Laying a wreath at the foot of the statue of Sir Clements Markham, the President of Peru said:

"My country wishes to render homage to the memory of Sir Clements Markham, for twelve years President of this Society, and who wrote several works on Peru's history, geography and resources, which showed him as a very loyal friend of Peru in hours of national crisis."

Maps, drawings and books by Sir Clements Markham were on show in the Society's Museum, and Lord Nathan presented the President with a copy of the Gough Map.

"THE MAPPING OF BRITAIN"

An exhibition was held in the Society's House from 29 December 1959 to 20 January 1960 under the title "The mapping of Britain." It was organized by the Ordnance Survey, whose representatives were on duty daily to show visitors round and to explain the exhibits. These included maps in all stages of preparation, and techniques for the study of data and the reproduction of maps on all scales. Over 4500 people visited the exhibition, including parties from fifty-four colleges and schools in or near London.

SHACKLETON'S *NIMROD*

Recently, the Society received from Mrs. H. A. Moore a ship's bell engraved "Nimrod . Riga," which she believed to be from the *Nimrod* of Shackleton's Antarctic Expedition of 1907–9. Captain J. K. Davis who served in her on this expedition doubted this identification, and has obtained the true facts from Captain W. R. Chaplin, C.B.E., of Trinity House, a Life Fellow of the Society. There were two *Nimrods*, as the following details from Lloyd's Register show. "1906–07. 'Nimrod.' Wood: screw barque. Built by A. Stephen & Son, Dundee, in 1866. 226 tons: owned by Job Bros. and registered at St. Johns, Newfoundland." In the Register for the following year, this entry is crossed through, with the notation in red ink: "Now a yacht. See Yacht Register: owner W. Beardmore," showing that she had been sold and re-registered as a yacht. In both these Registers, and in those before and after, is the entry: "'Nimrod.' Wood: 3-masted schooner. 411 tons. Built 1890: owner

P. Anderson. Registered at Riga." The first entry clearly relates to Shackleton's ship, which was a total wreck off East Anglia during the First World War. The *Nimrod* of Riga was broken up at a South Coast port in the early 'twenties, when the bell was purchased. Since others were also under the impression that she was associated with Shackleton, it is useful to have these facts on record. We are indebted to Captain Davis and Captain Chaplin for their help in establishing them.

THE RECORD

CONTRIBUTORS TO THIS ISSUE OF THE *JOURNAL*

Sir Charles Darwin, K.B.E., F.R.S., Master of Christ's College, Cambridge, from 1936 to 1938 and Director of the National Physical Laboratory from 1938 to 1949, is a grandson of Charles Darwin. *Mr. W. H. Reeve* is the Director of the Geological Survey Department, Northern Rhodesia. *Professor H. C. Darby* is Professor of Geography, University College, London. *Sir Gavin de Beer*, F.R.S., F.S.A., was formerly a temporary Colonel, Grenadier Guards, Professor of Embryology, University College London, and Director, British Museum (Natural History). *Dr. M. M. Cole*, at present studying savanna conditions in Australia, is on the staff of the geography department, University College of North Staffordshire, Keele. *Professor D. J. M. Hooson* is Assistant Professor of Geography, University of British Columbia. *Mr. K. L. Wallwork*, on the staff of the geography department in the University of Leicester, won the Society's Essay Prize in 1955 for earlier work on subsidence in Cheshire. *Mr. J. R. V. Prescott* and *Mr. H. P. White* are both on the staff of the geography department in the University College of Ibadan.

APPLICATIONS FOR GRANTS 1961

Applications for grants for both exploration and research for the year 1961 must reach the Director and Secretary not later than 20 *February* 1961; it is only in very exceptional circumstances that later applications can be considered. Applications must be *typed* on the Society's own form, which can be obtained on request; they must be accompanied by evidence of support from institutions or qualified individuals supporting the proposed expedition or research. Leaders of expeditions and other applicants for grants may be expected to attend an interviewing board.

Expedition leaders are asked, when dealing with the Press, not to use the Society's name in connection with their expedition until they have received official approval of the Council.

Applications for grants from the Mount Everest Foundation must be made to the Secretary at 74, South Audley Street, London, W.1., on the printed form to be obtained from the Foundation. Applications should be made not later than 15 September 1960, 31 December 1960, 1 March 1961, according to the time of year when the expedition is due to leave. Applications arriving late for a particular date will be deferred to the next meeting of the Committee.

GRANTS TO EXPEDITIONS 1960

The Council has approved grants totalling £920 (including £45 from the Stephens Bequest and £50 from the Penruddocke Fund) to seventeen expeditions in 1960, and seventeen further expeditions have been approved; instruments have been lent to twenty-two out of this total of thirty-four expeditions. Details (to 21 March 1960) are as follows:

Financial aid.—London University Geological Expedition to Skidadalur, Iceland (£50 plus instruments); London University Expedition to North Iceland (£50 plus instruments); University College Geographical Expedition to Morocco (£75 plus instruments); Oxford University Expedition to Cyrenaica (£100 plus instruments); Oxford Women's Azores Expedition (£50 plus instruments); Cambridge Expedition to Svartisen (£25); Cambridge Expedition to La Palma (£50); Cambridge Ecuador Expedition (£50); Cambridge Botanical Expedition to Finnmark (£50 from Stephens

Bequest); Durham University Faroes Expedition (£50); Wye College Moroccan Expedition (£50); Oxford and Cambridge Expedition to Mali (£50 plus £50 from Penruddocke-Park-Lander Bequest plus instruments); Oxford University Expedition to Ecuador (£50 plus instruments); Imperial College Jan Mayen Expedition (£20 plus instruments); British East Greenland Expedition (£50 plus instruments); Oxford Icelandic Expedition (£50); Saltoro Expedition 1960 (£50 plus instruments).

Approval and instruments.—Imperial College Expedition to St. Kitts, West Indies; Imperial College Expedition to Iceland; Oxford Andean Expedition; Oxford University Expedition to Turkey; Oxford and Cambridge Finnmark Expedition; South Patagonia Survey Expedition; Anglo-American Karakoram Expedition; Scottish Spitsbergen Physiology Expedition; Himalayan Scientific and Mountaineering Expedition; Abinger Afghanistan Expedition; Glasgow University Geography Department Expedition to Gornergletscher; British-Indian Nepalese Services Himalayan Expedition.

Approval only.—Imperial College Expedition to Iran; Cambridge Expedition to British Guiana; Imperial College Iceland Expedition; Oxford Arctic Norway Expedition; Royal Horticultural Society's Iranian and Turkish Mountain Expedition.

Of the above expeditions, the following have also received ciné-cameras and equipment purchased out of a grant from the Calouste Gulbenkian Foundation, Lisbon: Oxford University Expedition to Cyrenaica; Oxford and Cambridge Finnmark Expedition; Oxford and Cambridge Expedition to Mali; South Patagonia Survey Expedition.

Substantial grants in aid were also made to expeditions in mountain regions by the Mount Everest Foundation, constituted by the Society and the Alpine Club.

COMMONWEALTH TRANS-ANTARCTIC EXPEDITION 1955–58

Educational Productions, Ltd., of London and Wakefield have prepared for the London County Council a very successful film strip for use in schools. It is particularly gratifying to find that 42 carefully selected pictures from the expedition's collection of colour photographs were made available for the production of this remarkably striking filmstrip. And it is safe to say that no geography department in school or college should be without this set of pictures. There is hardly a frame that has not something of interest to show and to teach. One of the most striking photographs is that of the upper limit of the sun just appearing on the horizon on August 10, the herald of better days to come. How welcome it must have been! The lecture notes are excellent in every way—terse and to the point yet containing a wealth of authentic information. The colour is pleasing and adds significantly to the value of the strip. The use of these pictures in the classroom or lecture room will undoubtedly provide an underpinning of visual fact for our teaching, and therefore they can be heartily recommended. E. R. DUDLYKE

THE INSTITUTE OF BRITISH GEOGRAPHERS

The Annual Conference of the Institute met for the first time at Southampton from 1 to 5 January 1960, and was attended by about 250 members who were accommodated in University Halls of Residence. The new lecture theatre of the University Faculty of Engineering provided an excellently equipped setting for meetings and lectures. In the absence of the President, Professor W. G. East, in California, the Vice-President, Professor K. C. Edwards, presided over the Conference. The opening lecture, an introduction to the Southampton area by Professor F. J. Monkhouse, served admirably as a prelude to the excursions which ranged widely both in their itineraries and in their fields of interest. These excursions were ably organized and led by members of the staff of the local University and were much appreciated by the participants.

The Annual Dinner of the Institute, held on Saturday, January 2, in the University Refectory, was preceded by a reception at which the Vice-Chancellor and Mrs. James welcomed members to Southampton on behalf of the University. An afternoon

session was devoted to concurrent discussions of climatological problems and the uses of Census data in social geography, and the Sunday evening meeting took the form of an illustrated report by the leader, Professor K. C. Edwards, on the visit to Poland in September 1959 by twelve delegates of the Institute who took part in an Anglo-Polish seminar on the practical applications of geographical research in physical and economic planning. At other sessions geomorphology, as usual, was well represented by four papers from Professors Austin Miller and S. W. Wooldridge, Mr. A. Straw and Mr. J. Palmer. In a varied programme, however, planning problems in Monsoon Asia were also dealt with in papers by Mr. Farmer and Dr. Learmonth, the geography of disease in a paper on cancer mortality in Wales by Dr. G. M. Howe, the geography of communications in a paper on the Watford gap, Northants., by Mr. J. H. Appleton, and Professor Arthur Davies provided his elucidation of some of the obscurities surrounding Columbus's voyages in a paper entitled "Columbus and the unknown pilot."

Next year members will be the guests of the University College of Wales at Aberystwyth for the Annual Conference from 6 to 10 January 1961. A. E. SMAILES

INDIAN TRIBES OF THE RIVERS ARINOS-JURUENA REGION

Information has been received from Mr. P. M. Chapman about a group of Indian tribes native to the Mato Grosso State of the United States of Brazil. The information comes from the Resident Director of a colonization venture deep in the forest lands and some 600 kilometres from the State capital, Cuiabá. The venture is a commercial enterprise, and those at the head of it would be glad to interest the outside world in these hitherto unknown tribes, and to assist any expedition which might like to penetrate to Gleba Arinos, the site of the experiment. The address of the Resident Director is: Snr. Guilherme Mayer, Porto dos Gauchos, a/c Colonizadora Noroeste Matogrossense Limitada, Caixa Postal, 228, Cuiabá—Mato Grosso, Brasil. Some account of the people and country is given below, translated from the original Portuguese by Mr. Chapman.

"In Gleba Arinos we are acquainted with three tribes who are our neighbours—the Caiabis, the Canoeiros and the Tapaiunas.

"We had our first contact with the Caiabis who live around the source of the River dos Peixes. These Indians are completely tame after four years contact with civilization under the guidance of the missionary Padre João Ev. Dornstauder, S.J. Already on divers occasions small groups of them have visited us, bringing weapons, utensils, etc., to exchange for clothes and other articles. Also people from here have visited them and there has never been any kind of hostility. Lately, *i.e.* since 1958, the missionary has been concentrating his pacification work among the Canoeiros who are divided up into many tribes spread over a large area. For example, they live on the banks of the rivers do Sangue and Papagaio, at the junction of the rivers Arinos and Juruena, etc. The Canoeiro Indian is more hostile and is feared by the Caiabis. The different tribes have little contact; they are frightened of each other. The Rio Papagaio tribe killed seven rubber collectors in one year and these incidents continue. It is perhaps not entirely true to say that the Indian is hostile, but that he became so after contact with the rubber men who, in the opinion of Padre João, are more dangerous to the Indians than the opposite. Due to their distance from here we have not yet had any direct contact with the Canoeiros and all our knowledge is based on the information of Padre João who is an expert on the subject. We call them the Canoeiros (the Canoers) because they construct canoes for river crossings, while the other more primitive types make rafts.

"The types of rafts (three or four logs bound together) are much seen on the Rio Arinos above our settlement where the Tapaiunas live. Very little is known about them. Since the beginning of the colonization of our land they have appeared from time to time to fire arrows at the launches. Up to the present time they have caused no harm to us apart from an arrow wound to one of our engineers. The rubber men of

that region named them the 'Beiço-de-Pau' (wooden lips); they fear these Indians, and pursue them. We always doubted whether they were in fact users of the lip ornament and it was only in December 1958 that we received information which was a little more precise. They became even more dangerous, killing and wounding the rubber collectors and survey personnel so that we felt we had to take some action in the matter. An employee of ours, Mr. Fritz Tolksdorf, who has also already visited the Caiabis, joined up with Padre João and with our help they went off to make contact with these Indians. Two kilometres from the Rio Arinos, up the stream Tomé da França, they came upon the first camp of two shelters. Further into the interior

they found another two pairs and at 16 kilometres, a larger encampment. The men managed to see only one Indian, who fired an arrow at the launch. They are able to state that the type of Indian is very different from the others they know, not only in their appearance but also in their methods of living. They do not use hammocks but make up beds on the ground and line them with leaves. In each shelter there are six beds which probably corresponds to six families; a fireplace is beside each bed. In front of the shelters there is a smaller hut, either for the chief or a watchman. They found wooden shapes suitable, and of a size, for placing in lips so they do appear to be 'Beiço-de-Pau.' They saw no Indian with the ornament in place, and so they are unable to affirm one way or the other. It could be that these Indians looted the wooden shapes from another tribe which, it is known, passed this way

towards the east some twenty years ago and they *were* users of the ornament. It is also possible that some of these Indians remained here on the Arinos.

"A map is attached of the region Arinos-Juruena which is situated in the north of the State of Mato Grosso. We have marked the approximate areas inhabited by the various tribes. The information we have been able to give is not complete or precise and it is for this reason that it would be an interesting task for a scientific expedition to get well acquainted with these Indians. If everything were clear, explored and described, it would no longer be an attractive subject. Gleba Arinos, a centre of civilization some hundreds of kilometres into the forestlands and right in the middle of the tribes, would serve as an excellent base for the work of such an expedition. We have an airstrip from which flights could be made to localize the villages; we have a hospital, doctor, food stores, vehicles and boats. In short, we have much that would assist the preparation and the actual work of an expedition."

JOHANNES FREDERICO HASENACK
Gleba Arinos, 20 *January* 1959.

NATIONAL RESEARCH COUNCIL, CANADA

At its meeting on 4 March 1960 at Ottawa the Associate Committee on Geodesy and Geophysics of the National Research Council constituted a Sub-Committee on Glaciology. The members are: Dr. G. Hattersley-Smith (Chairman), Mr. P. D. Baird, Mr. T. J. Blachut, Mr. G. Falconer, Dr. G. D. Garland, Mr. L. W. Gold, Professor F. S. Grant, Professor J. A. Jacobs, Dr. F. Muller-Battle, Professor S. Orvig, Dr. E. F. Roots, Dr. J. O. Wheeler. The purposes of the Sub-Committee are: To encourage and advise on research on glaciers in Canada; to collect and distribute information on glacier research; to assist in the publication of research material. The Sub-Committee hopes to keep in close touch with organizations outside Canada which are engaged in glaciological research. Enquiries may be addressed to the Sub-Committee at the National Research Council, Ottawa, 2.

INTERNATIONAL SYMPOSIUM: THE STUDY OF KARST PROBLEMS

An international symposium for the study of Karst problems was held in Vienna on 16–17 October 1959. The symposium was arranged by Professor H. Lehmann (Frankfurt), President of the Karst Commission of the International Geographical Union, and by Dr. F. Bauer of the Austrian Spelaeological Institute. Twenty-eight geographers and geologists from eight different countries, including Professor Kunsky from Czechoslovakia, took part; Dr. G. T. Warwick and Dr. M. M. Sweeting attended from Great Britain.

The meetings were held in the Geographical Institute of the University of Vienna, and the participants were welcomed by Professor Hans Spreitzer, the head of the Institute. The main part of the symposium was devoted to a series of short papers and discussions on topics of current research in Karst areas. The main topics were: (1) the project of an international atlas of Karst land forms; (2) the problem of the relative rates of Karst erosion; (3) new ideas on the chemical phases of solution of limestones and the origin of lapiés; (4) the problem of the origin of Karstic depressions, particularly *poljes*; (5) the question of the development of hydrographical stages in Karst areas and the origin of Karst "levellings." Lively discussions took place on all these topics. Perhaps the most interesting were those which dealt with the origin of *poljes*, and the question of the hydrographical zones, in which there was much argument concerning the formation of Karst plains (*Ebene*) by corrosion. Professor Roglič (Zagreb) gave an interesting exposition of the development of Cvijic's ideas on the cycle of evolution in Karst land forms; he stressed the modern view of the independence from any cyclic development of both *poljes* and of the hydrographical zones. A paper by Dr. Warwick reminded us of the problem of water-tables in Karst areas, as controversial a subject as ever in Karst morphology. Much of the most recent work in limestone areas, particularly on the rate of evolution of the land forms, is of a chemical character and some of the problems in this field were considered by Dr. Bögli (Lucerne) and also by Dr. Sweeting, who dealt with Australian examples.

Members of the symposium were most kindly entertained to lunch by the Bürgermeister of Vienna and also by Professor and Frau Böbeck. The symposium ended with a delightfully informal tour of Vienna and its surroundings, arranged by the City Planning Department and directed by Dr. E. L. Raab. M. M. SWEETING

THIRD CONGRESS OF THE GEOGRAPHICAL SOCIETY OF THE U.S.S.R.

The Third (post-war) Congress of the Geographical Society of the U.S.S.R. was held in Kiev from 20 January to 7 February 1960, previous congresses having been in Leningrad in 1947 and Moscow in 1955. It was attended by about 1100 geographers, 231 of whom were elected delegates from the branches of the Society (elected on a scale of one for 40 members). Of the remainder, 382 were from cities and towns of the Soviet Union other than Kiev and 14 were overseas visitors, from Great Britain, U.S.A., Canada, Italy, Poland, Czechoslovakia, Hungary, Bulgaria and Romania. At the opening session, the Vice-President, Professor S. V. Kalesnik, presented a report on the activity of the Society. Membership is now 9960, nearly 4000 more than in 1955, over half of whom belong to the Leningrad, Moscow, Ukrainian and Georgian branches. In all, there are 24 main branches (*filialy*), 84 minor branches (*otdely*) and 16 sub-branches. In the past five years the Society has organized over 60 scientific conferences and over 6700 papers have been presented to branches. More than 180 expeditions were organized.

The main work of the Congress consisted of six symposia on set themes, each symposium consisting of a number of papers, printed and circulated in advance, and then discussion periods, ranging up to several days. For the most part, papers were general surveys of work done or considerations of theoretical problems, but much information on individual research topics was given in the discussions. After the discussions, resolutions were drawn up, stating the main lines along which research was needed, proposing the setting up of sub-committees, urging action on official bodies and the like. The symposium "The role of geography in the study, use, conservation and renewal of natural resources of the U.S.S.R." attracted the largest number of papers (11) and 26 pages of resolutions were drawn up. Sharpest discussion came in the symposium on "Economic regionalization of the U.S.S.R.," where the criteria for the areal delimitation of the new regional economic structure of the country were debated for over 20 hours. The other symposia were "Natural (physical geographical) regionalization of the country for the purposes of agriculture," "General theory and practical application of methods of landscape study" (in which much discussion was devoted to terminology), "The water—heat regime of the earth's surface" and "The state of geography in Middle and Higher Schools in connection with the reform of Middle and Higher Education." In this last symposium, considerable dissatisfaction was expressed at the shorter teaching hours of geography in schools. In addition to the symposia, there were lectures on geographical exploration, talks by Soviet geographers on their visits to foreign countries (including Academician I. P. Gerasimov on his visit to Great Britain in 1958), and geographical films.

One of the most interesting parts of the Congress was a large and well-displayed exhibition of books, maps, and current research being conducted by the various branches. The Congress ended with the election of officers and the Scientific Council of the Society. The Council, the main governing body, consists of 43 elected members and, *ex officio*, the 14 Presidents of the Union Republic branches. Re-elected for a further five years were the President of the Society, Academician Ye. N. Pavlovskiy, and the Vice-Presidents, Professor S. V. Kalesnik and Academician I. P. Gerasimov.
R. A. FRENCH

I.G.U. CONGRESS, STOCKHOLM: CHANGE OF PROGRAMME

The Norwegian National Committee of Geography (Norges Handelshøyskole, Geografisk Institutt, Bergen, Norway) have cancelled the fjord excursion EN4 which was arranged in connection with the Nineteenth International Geographical Congress at Stockholm. Instead, a shorter and less expensive excursion is offered with M/S

Brand IV, August 13–21: leaders, Dr. Tore Sund and Dr. Tore Ouren, the Norwegian School of Economics.

OVERSEAS GEOLOGICAL SURVEYS

The Annual Report of the Overseas Geological Surveys for the year beginning September 1957 (H.M.S.O., 1959, 2*s* 6*d*) has been received. The Director, Dr. F. Dixey, who has since retired from this post, gives a brief account of the more important work of the seventeen Geological Surveys with which the Directorate is concerned, and more detailed accounts from each territory follow. Some notable points are the increasing use of geophysics, geochemistry and drilling; the discovery of a third oil-bearing locality near Soku, Nigeria, of important coal deposits in Swaziland, and the location of local supplies of stone for road-making in Borneo. The Director spent the period April–June 1958 in making a geomorphological study of central and southern Madagascar. Cooperation between university staffs and the Directorate continued through the year.

FOURTH SOVIET ANTARCTIC EXPEDITION

On the last page of *Soviet News* (published by the Press Department of the Soviet Embassy in London) dated 30 March 1960, there is an account of the Fourth Soviet Antarctic Expedition. Led by Alexander Dralkin, the expedition returned to Riga on March 28 on board the *Ko-operatsia* after spending thirteen months in the Antarctic. Lazarev scientific station was set up in Dronning Maud Land, and geologists located a mountain range to the south which was named "Russian Mountains." "The expedition," runs the account in the *Soviet News*, "made . . . a scientific trek from the shores of the Indian Ocean to the Geographical South Pole and back, covering a distance of nearly 2500 miles to the Vostok station." A fifth expedition, led by geographer Evgeny Korotkevich, is now working in Antarctica.

CONFERENCE ON INDUSTRIAL ARCHAEOLOGY

A Conference on Industrial Archaeology was held by the Council for British Archaeology on 12 December 1959 at the London School of Hygiene and Tropical Medicine. The chair was taken by Dr. J. N. L. Myres, President of the C.B.A., and papers were read by Mr. M. M. Rix, Mr. J. M. Palmer, Professor A. W. Skempton, Dr. P. M. G. Eden, Mr. J. M. Richards, and on behalf of Mr. C. W. Phillips, Archaeology Officer of the Ordnance Survey. Among the many interesting monuments mentioned were the 1779 iron bridge over the Severn gorge, together with the furnace at which the bridge was cast, and the cast-iron aqueduct by Telford on the Shrewsbury branch of the Shropshire Canal.

Reports of the conference show how wide is the field for the comparatively new pursuit of "industrial archaeology," and the interest which geographers, together with historians and economists, may well take in the subject. Since 1950 the Ordnance Survey has encouraged the recording of industrial monuments, and since 1959 it has been official policy to record all important features of the cultural landscape which are more than 100 years old. The present revision of the country on the scale of 25 inches to the mile is taking account of all important industrial buildings. A case was made at the Conference for the preservation of industrial remains in remote areas, such as the charcoal-using blast furnace at Bonawe in Argyll, built in 1753 and abandoned as recently as the 1870's, of which Professor A. C. O'Dell, Professor of Geography at Aberdeen, has made a survey.

The Council of British Archaeology is preparing a handbook on industrial archaeology; enquiries to the Assistant Secretary, Miss B. de Cardi, F.S.A., 10, Bolton Gardens, London, S.W.5.

SYMPOSIA ON ASPECTS OF AGRICULTURAL METEOROLOGY

On 16 March 1960 the Third Symposium in this series was convened by James A. Taylor, lecturer in geography at the University College of Wales, Aberystwyth.

The First Symposium was held in March 1958, when "The growing season concept" was discussed with special reference to the British Isles; some forty people attended, mostly local agriculturalists with a few geographers, meteorologists and foresters. The Second Symposium, in March 1959, with a similar attendance, discussed "Shelter problems in relation to crop and animal husbandry." Memoranda Nos. 1 and 2—"The growing season" and "Shelter problems in relation to crop and animal husbandry"—were issued, based on the two earlier symposia, and are available on application to Mr. James A. Taylor at the Department of Geography and Anthropology, University College of Wales, Alexandra Road, Aberystwyth, Cards.

The Third Symposium of March 1960 concentrated on "Hill climates and land usage, with special reference to the highland zone of Britain." Some sixty people attended, including geographers, agriculturalists, meteorologists, botanists, ecologists and foresters, representing university and government departments in England and Scotland as well as in Wales. After being welcomed by Professor E. G. Bowen (Gregynog Professor of Geography and Anthropology, Aberystwyth) the meeting was first addressed by Mr. Taylor, who indicated the general properties of hill weather and climate, and associated soil and vegetation patterns, in relation to growth potentials. Mr. J. Oliver (Geography Department, University College, Swansea) demonstrated the excessive deterioration of growth potential with altitude in an oceanic climate by presenting data from personally established meteorological stations on the Brecon Beacons. Dr. G. M. Howe (Geography Department, U.C.W., Aberystwyth) then discussed components of the water budget in upland Wales in a general way. Particular illustration was afforded by reference to data recently obtained for the water balance of the Ystwyth catchment by Mr. J. C. Rodda, a geography research student at Aberystwyth. Dr. R. W. Gloyne (Meteorological Office) summarized the significance of wind as a factor in hill climates, and showed how the geometry of the land surface can determine degrees of local exposure. The afternoon session was addressed successively by Professor J. E. Nichols (Department of Animal Husbandry, U.C.W., Aberystwyth), Mr. G. Forrest (Forestry Commission), Dr. S. Gregory (Geography Department, University of Liverpool) and Dr. R. E. Hughes (Nature Conservancy) on the points of view respectively of the hill farmer, the forester, the hydrologist, and the ecologist.

Memorandum No. 3, "Hill climates and land usage, with special reference to Highland Britain," is in course of preparation and will be available shortly on application to Mr. Taylor at the address already given for Memoranda 1 and 2. The Fourth Symposium will be held in March 1961

NOTES

The Managers of the ROYAL INSTITUTION wish it to be known that the Institution's Library is open to persons who are not Members of the Institution. No charge is made for readers' tickets, and application forms with all particulars may be obtained from the Secretary or Librarian, the Royal Institution, 21, Albemarle Street, London, W.1. Readers must be over eighteen years of age and must be sponsored by a responsible person to whom they are personally known.

* * *

In SCIENCE PROGRESS, No. 188, October 1959, Dr. G. E. R. Deacon, Director of the National Institute of Oceanography at Wormley, writes comprehensively and in detail of the influence of the Antarctic Ocean on the rest of the world. In this authoritative article, his observations are arranged under convenient subheadings describing conditions in the Antarctic Bottom Water and the Surface Water, the Water Masses and the relevance of the Antarctic convergence. There is a section on the subantarctic

zone and subtropical convergence dealing mainly with temperatures. The climatological and zoogeographical significance of the convergence is also examined. In conclusion Mr. Deacon outlines future requirements. There is a useful bibliography, a diagram and maps.

* * *

EXPLORATION REVIEW, February 1960, the first issue of the Journal of the Imperial College Exploration Society (founded in 1955), has a number of reports on expeditions organized by the College in 1959. The Azores (Underwater) Expedition was so successful that a second major one is being planned for the summer of 1961. All those interested are invited to apply immediately to the Hon. Sec. of the Imperial College Underwater Club. Previous experience of diving is not required. Instruction will be given to members at the I.C.U.C. meetings during the year. No less than sixteen expeditions have been organized and undertaken by the college since 1956. Towards the end of the journal there is an informative article about the Royal Geographical Society which quotes Lord Nathan in his Presidential address to the Society: "Initiative, unselfishness, a better understanding of other lands and people—these are only some of the invaluable lessons expedition life can teach. To encourage by every means this latent spirit of adventure among the youth of this country and of the Commonwealth and to guide it along the right lines seems to me to be a duty most appropriate to our society in this new Elizabethan age."

* * *

The THOMAS CAWTHORN MEMORIAL LECTURE No. 33, for 1958, was given by Sir Edmund Hillary on 21 October 1958 at Nelson, New Zealand. In speaking on "The New Zealand Antarctic Expedition," Sir Edmund covered three general topics: the buildings at Scott Base, the vehicles used by the New Zealand team and the question of dogs and their future in Antarctica. The lecture has been printed as a pamphlet which is in the Society's Library.

OBITUARY

SIR LEONARD WOOLLEY

Sir Leonard Woolley, elected a Fellow of the Society in 1945, died in London on 20 February 1960. Charles Leonard Woolley was born on 17 April 1880, the son of the Rev. George Herbert and Sarah Woolley, and was educated at St. John's, Leatherhead, and New College, Oxford. He graduated with honours in theology, but on the advice of Warden Spooner decided to make a career in archaeology, and soon after coming down from Oxford was appointed assistant to Sir Arthur Evans, then Keeper of the Ashmolean. Woolley's earliest excavations were at Corbridge on the Roman Wall in 1906, but the work in the Near and Middle East in which he made his name may be said to have begun in the following year, when he joined Randall MacIver in Nubia, and excavated, at Karanog, the first known Meroitic cemetery. In 1912 Woolley succeeded Dr. R. Campbell Thompson as leader of the British Museum expedition to Carchemish in Syria, and during the off-season of January and February 1914 he and T. E. Lawrence made a survey in Palestine of the country between 'Aqaba and the Dead Sea.

He served at sea during the early part of the First World War and spent 1916–18 in a Turkish prison camp, resuming his work at Carchemish in 1919. In 1922 he embarked on the excavations at Ur which constitute his great contribution to the archaeology of the Middle East, working there steadily for the next thirteen years. He contrived to complete the last two of the series of six massive volumes on Ur just before his death. His subsequent work at Al Mina near Antioch, and at Atchana in

the Hatay in the years just before and after the Second World War, resulted in many interesting discoveries, and worthy of mention also is his appointment in 1938 as adviser to the Government of India on their archaeological programme; the subsequent development of archaeological discovery in both India and Pakistan owes much to Woolley's counsels.

During the Second World War he served from 1939 to 1943 as a major in the Directorate of Public Relations and was responsible for the creation of a monuments, fine arts and archives branch of Civil Affairs. From 1943 to 1946 he was Archaeological Adviser to the Civil Affairs Directorate, and was chiefly responsible for the safeguarding of many valuable works of art when Italy became a battlefield in the latter part of the War.

Few archaeologists have been more conscious than Leonard Woolley of the significance of geographical factors in the development of the ancient civilizations which he studied. This was apparent in his whole attitude to archaeology, which was never confined by narrow technical and specialist margins but which ranged widely over the whole field of the ancient world, taking into account all the links, the contacts and the influences which make up the fabric of ancient civilizations. He was a man of prodigious industry and his literary output, whether for the specialist or the general reader, was remarkable. In all this writing, as in his lectures and talks, he had a wonderful gift for clear, lucid and vivid exposition by which he was able, no matter how complicated the material, to bring the fruits of his research to life.

Personally, his most attractive characteristic was his fund of buoyant youthful enthusiasm which he never lost even in old age. He loved his profession and, though he had been through some hard and difficult times, it is not easy to think of a man who more thoroughly enjoyed his life. Professionally, the name of Leonard Woolley stands high among the great archaeologists of the twentieth century. As a man he was kind and gentle. He will be missed by countless friends. L. P. KIRWAN

PROFESSOR W. W. JERVIS

By the sudden death of Walter William Jervis on 4 November 1959 the ranks of academic geographers in Britain lost a senior member who had given long and faithful service to the subject as head of the geography department of Bristol University. A north-countryman by birth, Professor Jervis graduated B.Sc. in geology in the then Armstrong College of Durham University, and held his first academic post as lecturer in geology and mathematics in the University College of the South-West. After one year in Exeter the First World War drew him away from academic life, and for the next four years he served with the Army in India, the Near East and France. On return, he joined in 1920 the staff of the geology department in Bristol University, with responsibility for the instruction in geography; and when, in 1924, it was decided to separate the two subjects, he was placed in charge of the new geography department. In 1926 he was made reader in geography; and in 1933, when a full Honours School in the Science Faculty was added to the existing one in Arts, he was appointed to the newly created chair of geography. This appointment he held until his retirement in 1957, when he was elected Professor Emeritus.

Professor Jervis, like most others of his generation, thus came into geography from another subject, and throughout his life his interests ranged widely. His early studies in geography centred on Greenland, and for these he was awarded the degree of D.Sc. by Durham University; but later his interests turned to climate, the evolution of maps, and latterly the human and political geography of Europe. His book 'The world in maps' appeared in 1936, and he published papers on the climates of the Mediterranean basin, and on the geography of the Bristol region. He also found time to study law and to qualify as a barrister, an interest reflected in some aspects of his teaching. But his energies in later years turned from research increasingly towards building up and strengthening his department and to wider services to his university and city. By appointing O. D. Kendall, he early introduced specialized courses in

surveying, and his Department achieved a high reputation in this field, a large number of his students finding careers as surveyors in the Colonies. He also consistently encouraged his students to continue geographical studies after graduation and, whenever possible, to aim at higher degrees. At his retirement he could contemplate with satisfaction a department grown to a size ranking high among those of British universities, strongly based in both Science and Arts Faculties, and favourably placed for future development.

Outside his department Professor Jervis gave long assistance to the Geographical Association, and he was for most of his working life a Fellow of the Royal Geographical Society, to which he was elected in 1915. In the University he served as a member of Senate for twenty-seven years, and from 1936–9 he was Dean of the Arts Faculty. He represented Bristol University on the Council of Exeter University and on the Wiltshire Education Committee, and within the University he took a great interest in student athletic pursuits. In the City of Bristol he was a Governor of Colston's School, and an active Freemason, an organization in which he held high office. Professor Jervis will be remembered by his friends and colleagues for his long and loyal services to his subject and university, for his wide range of interests and his entertaining conversation. By his many former students, especially those scattered in distant parts of the earth, he will be particularly remembered for his great interest in them individually, and for the way in which he kept in touch with them after they had left his department. He leaves a son and a daughter, to whom all sympathies are extended.

R. F. PEEL

WILFRID JENNINGS BRAMLY, M.B.E., M.C.

Born in 1871, in 1891 W. E. Jennings Bramly, whose Elizabethan spelling had prevented his entry to Sandhurst, came to Egypt. While being groomed for the post of private secretary to the Khedive Tewfik, his patron died and Bramly embarked on some work for the Palestine Exploration Fund near 'Ain Qadeis in Northern Sinai. In 1896 he started the nucleus of the Cairo Zoo in the gardens of the ruined Palace of Giza. In 1897, he went west of the Nile from Cairo to Siwa. To that oasis others had preceded him, but Bramly was the first actually to enter the walled city. A rash visit to the mosque aroused suspicion and he and his guide fled southwards through the dunes to the uninhabited well of 'Ain Dalla, till then unknown to geographers, which proved such a useful jumping-off point for the crossings of the Sand Sea by the L.R.D.G. during the last war. No scholar, but with enough Arabic to understand what was said to him and answer plausibly, Bramly did pass as a Syrian in Sinai and, to win a bet, once travelled from Alexandria to Siena, in Bedouin dress and speaking only Arabic. In 1898 he visited the porphyry quarries in the Eastern Desert. In 1901, he went to the newly reconquered Sudan where, among the "Fuzzies" of the Etbai, he met many kindred chivalrous spirits. Indeed, he declared to the Director of Education that Malory's 'Morte d'Arthur' should be translated into To Bedauye: "That is all they need!" Among them, he learned to *ride* a camel and instituted an annual 50-mile race at El-Damer. In the first of these, he came in second in four hours and twenty minutes, though he said he was not competing but refereeing. In 1905, he was recalled to Egypt and, one dawn, saw from Nakhl Fort in Sinai the empty desert to the east filled with an army advancing with banners. A Turkish invasion was threatening; but this turned out to be the very last of the Hajj caravans to return from Mecca to Egypt by land. At the end of the year, he audaciously ventured to El-'Aqaba with a handful of police. The Turks retorted by occupying Taba. This began the famous "'Aqaba Incident" and Bramly was blamed for it by Wilfrid Scawen Blunt in his 'Secret History of Egypt.' But, recently, Bramly declared to General Marshall-Cornwall that he had "orders to go to El-'Aqaba."* Since the Turks claimed with some justice that the frontier ran from Rafah to Suez, the line

* See *Geogr. J.*, 125 (1959), pp. 459–62.

adopted in 1906 from Rafah to Taba represented a liberal concession on their part. They stipulated, however, that Bramly had to leave Sinai.

Unfortunately for him he did not return to the Sudan, where the civil administration was being handed over to more literate graduates from the universities. Instead, he was employed in the Recruiting Department where a titanic problem confronted him. "Bedouin Arabs" were then exempt from conscription, a concession meant to exclude nomads. But not only the nomads but the tribes settled on the fringe of the Nile cultivation with many alleged "descendants of the Arab conquerors of A.D. 632" claimed exemption too—600,000 in all. During his investigation Bramly amassed heaps of Arab genealogies which he later generously placed at my disposal when I was compiling my 'Sons of Ishmael.' But, though pressed, he always refused to allow his name to appear as joint author.

During the First World War, he was employed in the campaign against the Senusi and there won the hearts of the Libyan Bedouin. So sincere and unselfish did he appear to them that an old sheikh once asked me if Bramly was not *mrabit* or "dedicated" to the service of his fellow men. Resolved that the new province of the Western Desert should have a worthy capital, Bramly began to build one at Burg el-'Arab, 20 miles west of Alexandria. Here the sheikhs were annually to do homage to their sovereign; here trade caravans from the west were to halt on their last night before entering Alexandria. There was no money for the scheme but lots of official disapproval. On this Bramly throve and, somehow or other, Burg el-'Arab got itself built —a Mauresque gem of a town among tamarisk and olive groves. In the memories of the Eighth Army it must remain as a pleasant place. On the hill above, Bramly built his own lovely house where, throughout the war, he and his wife resisted all Army advice to leave. Ten more happy years followed. But, though the Eighth Army could not drive Bramly out, the Egyptian Army did in 1955 and his last years were spent in exile in Florence. In the early part of 1960 he died, undaunted. His gallant wife, a daughter of the late Baron de Cosson, the great authority on armour, and two daughters survive him.

G. W. MURRAY

MEETINGS: SESSION 1959–60

Meeting of 8 February 1960. Sir James Marshall-Cornwall in the Chair

Elections to Fellowship: L. M. J. Standon-Batt, B.A.; David G. Evans; Miss Margot Hamilton; Rev. Albert Herd; Cyril Jowsey, O.B.E., I.S.O.; Sydney R. Napper; Group Captain G. W. Peel; James T. Pennington, B.SC.; P. E. Perera; David M. Potter; Mrs. Marjorie R. Preston, B.A.; Dr. Anthony S. Reyner; Miss Jean Mary Smith; Andrew C. Stuart; Sir George Wilkinson, Bt., K.C.V.O.; A. C. S. Wright; Mrs. Patricia A. Wright

Elections to Associate Membership: Brian W. Adams; Miss Sheila Hill; Miss Frances M. Legget; Dennis J. Morrison; Miss Elizabeth Soddy; David E. Sugden; Miss J. V. M. Turland; Miss J. A. Whitaker

Paper: The Channel Tunnel. By J. H. B. Harding

Meeting of 15 February 1960. Dr. George Taylor in the Chair

Film: Old Tibet. Colour films and commentary by Major George Sheriff, O.B.E.

Meeting of 29 February 1960. The President in the Chair

Elections to Fellowship: T. N. Agarwal; Squadron Leader D. F. Baker; Major G. A. Barnett, M.B.E.; Robit A. Bayliss, B.SC.; Arnold Bell; Frank J. Bond; Dr. Dusan Brkic; John P. Cole; A. W. L. Farrow; Miss A. Fitzwalter, M.A.; C. G. Graham; John Grove; A. F. Harrison; C. Hatterby; N. J. P. Hawken, M.C.; Miss A. M. Hemmings; Alfred Hill; A. MacG. Hogarth; J. C. N. Humphreys; C. D. A. S. Macrae; D. R. D. Meigs; J. K. Molyneaux, B.A.; J. N. F. Newall; J. H. O'Connor; Kenneth T. Percy;

Captain N. R. Perry; David Potter, B.A.; Arthur N. Riley; William E. Rudolph; David G. Samuel; Miss E. A. B. Simpson; Lady Alexander-Sinclair; D. W. Aoughan; Miss C. F. C. Steele; Mrs. M. L. Wiseman

Elections to Associate Membership: Miss J. M. Burgin; Miss M. R. Hardy; Miss F. M. Legget

Paper: The Oxford University Expedition to British Guiana. By A. J. Cain

Meeting of 7 March 1960. Professor J. A. Steers in the Chair

Paper: Medical geography in India and Pakistan. By A. T. A. Learmonth

Meeting of 14 March 1960. Sir James Marshall-Cornwall in the Chair

Elections to Fellowship: Miss M. M. A. Abbott, B.A.; H. Major Allen; G. H. Bate, B.SC.; Ronald A. Bullock; Stephen J. Cody; Richard D. T. Davies; John L. Earle; H. Cecil Evans; Miss Jane Grinham; Miss K. E. M. Harrison; James D. R. Howell; Mrs. J. T. Ingham; Captain M. F. R. Jones; Lawrence J. Lazarus; Hon. Mrs. D. C. McNaughton; John B. Peers; John F. A. Russell; John L. Russell; Robert F. Sharpe, M.A.; Thomas W. Smith, B.A.; John H. O. Spink; Reginald D. Stone; Sherif Tahir; Anthony Weston; A. C. Whitelaw, B.A.; Mrs. Sheila Wilson, B.SC.

Elections to Associate Membership: Ronald Catlow; Richard D. Hopper; Edward MacA. Purcell

Film: Underwater explorations off Sicily and Cyrenaica. Colour films with introduction and commentary by N. C. Flemming

Meeting of 21 March 1960. The President in the Chair

Elections to Fellowship: John J. E. Aarons; Rodmell Agar; Peter R. Andrew; Keith B. Atkinson; Lancelot Clark; Charles H. Fryer; Roy Gallop, B.A.; James R. Kurtz; David H. Law; C. R. B. Moore; Miss V. Spencer-Ness; Miss F. I. Rogers; Alan Smith; Major Reginald Soame; Colin Thomas; Berthold Tuz, M.A.; Daniel W. Weidner; Graham S. White; Thomas Bata

Elections to Associate Membership: Miss F. K. M. Bunton; James A. Campbell; John B. Crowther; Michael J. Sinclair

Paper: Islands of Western Patagonia. By Martin W. Holdgate

Meeting of 28 March 1960. Professor L. Dudley Stamp in the Chair

Paper: A new land use survey. By Miss A. Coleman

Meeting of 4 April 1960. Dr. G. de Q. Robin in the Chair

Elections to Fellowship: Harry M. Bewes, M.A.; Miss Margaret E. Blanchard; Peter P. Eaton, B.SC.; Captain R. H. Grant; Ahmed Osman, M.A.; Geoffrey R. Shovelton; Frank R. Young, B.SC.; Capt. L. Zamperini

Election to Associate Membership: John S. Jones

Film: North Pole. A U.S.S.R. film with English commentary.